ROAD SAFETY AUDIT

Gorham Street from Lowell Connector to Elm/Highland Streets
Lowell, MA

Project 604694

Final
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Prepared for:
Massachusetts
Department of Transportation

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Background

In an effort to reduce the number of crash-related fatalities and incapacitating injuries, Massachusetts Department of Transportation has developed a Strategic Highway Safety Plan. The mission of the Safety Plan is to "Develop, promote, implement, and evaluate data-driven, multidisciplinary strategies to maximize safety for users of the roadway system." One of the many strategies noted in the current Safety Plan is to "conduct Road Safety Audits (RSAs) at high-crash locations throughout the Commonwealth." A Road Safety Audit, as defined by the Federal Highway Administration (FHWA) is "a formal safety performance examination of an existing or future road or intersection by an independent audit team." Simply stated, an RSA is a relatively quick process that identifies safety improvements focused on decreasing the number and severity of roadway crashes. The safety improvements recommended typically vary from low cost measures to significant improvement projects.

This RSA evaluates the intersection of Gorham Street with the Lowell Connector, as well as a short segment of Gorham Street extending north of the intersection to Elm Street and south to Gallagher Square (Central Street) in Lowell, Massachusetts. The intersection of Gorham Street and the Connector is scheduled to be improved in 2018.

MassDOT's Highway Safety Improvement Program (HSIP) has identified an HSIP-eligible "cluster" of crashes on Gorham Street at both the Lowell Connector intersection and the Elm Street /Highland Street intersection, based on crash data from 2011-2013.

Project Data

An RSA was completed for Gorham Street on Tuesday, June 28, 2016 at the E. N. Rogers School on 43 Highland Street in Lowell, Massachusetts.

The agenda for this RSA meeting is provided in Appendix A of this report. As shown below in Table 1, the audit team was multidisciplinary with representatives from state, regional and local agencies providing expertise in the engineering, planning, and maintenance fields. Contact information for the RSA attendees is provided in Appendix B of this report.

Background material was provided within the email invitation sent on June 13, 2016, and supplemented with additional data via e-mail on June 22 to each participant in the RSA. This information included collision diagrams, crash data summaries, volumes and speeds for the study area. During the RSA meeting, these materials were reviewed as a group prior to the field visit to the intersections. During the RSA field visit, various safety issues were observed and identified. Following the RSA field visit, the team returned to discuss additional concerns and potential solutions for the existing safety issues.

Table 1: Participating Audit Team Members

Audit Team Member	Agency/Affiliation
Carrie Lavallee	MassDOT Project Manager
John Gregg	MassDOT District Traffic Engineer
Tim Roberts	MassDOT District Traffic Engineer
Lisa Schletzbaum	MassDOT Safety Management Unit
Adam Prichard	MassDOT
Brendan Mullan	MassDOT
Lisa DeMeo	Lowell City Engineer (DPW)
Mark Buckley	Lowell Police Department
Phillip Charron	Lowell Fire Department
Nicolás H. Bosonetto	Lowell Transportation Engineer (Planning Dept.)
Sidney Liang	Lowell Bicycle & Pedestrian Coordinator
Tim Connors	Mass State Police - Station A-1, Andover
Justin Howard	Northern Middlesex COG
David Freeman	Project Manager – CDR Maguire
Jim Coogan	Traffic Engineer – CDR Maguire

Project Location and Description

The study area includes a segment of Gorham Street and two signalized intersections: Gorham Street at the Lowell Connector; and Gorham Street at Highland/Elm Streets. It also includes unsignalized intersections at Gorham Street's intersections with South Highland Street, Keene Street, Walnut Street, South Street, and Auburn Street. The unsignalized intersection of South Street with Highland Street is included because of its proximity to and influence upon the Gorham/Elm/Highland Street signalized intersection.

The Lowell Connector is a 6-lane divided freeway that provides access to Rte. 3 and I-495 and terminates abruptly as a 4-lane highway at Gorham Street. Gorham Street is a 32-35 foot wide urban city street that provides access into Downtown Lowell. The neighborhood within and adjacent to the project limits is a densely developed residential area made up of single-family and multi-family units. There is some commercial activity along Gorham Street (bank, gas/convenience store/ lounge). There is a courthouse and middle school just beyond the project limits.

The study has been divided into four distinct sections:

1. Road Segment
   Gorham Street, south of Lowell Connector

   This segment of Gorham Street extends from its signalized intersection with Central Street (not part of this study) to the signalized intersection at the Lowell Connector, a distance of only about 500 feet. The road has one northbound and one southbound travel lane, with a parking lane on the west side, and signed time-limit parking along storefronts on the east side.

   This road is classified as an Urban Principal Arterial by MassDOT's Office of Transportation Planning, and is under the jurisdiction of the City of Lowell.

   There were only 2 crashes attributed to this short segment of road, indicative of the absence of intersecting streets or significant traffic generators, as well as reflecting traffic volumes that are far lower than the segment of Gorham Street to the north. The two crash events yield a crash rate of 3.70 crashes per million vehicle miles, essentially matching the District Four average of 3.49 acc/mvm. Due to the obviously low actual crash tally, the specific crash data at this location should not be considered statistically significant.

2. Road Segment
   Gorham Street, north of Lowell Connector

   This segment of Gorham Street extends from its signalized intersection with the Lowell Connector to its signalized intersection with Highland and Elm Streets, a distance of over 600 feet. The road has one northbound and one southbound travel lane, and parking is generally prohibited throughout. It intersects five sidestreets over this relatively short distance.

   This road is classified as an Urban Principal Arterial by MassDOT's Office of Transportation Planning, and is under the jurisdiction of the City of Lowell.

   Because this short segment is defined by two high-volume signalized intersections, the entire segment is influenced by the operation of the two traffic signals.

   The 18 crashes on this short segment of road yield a crash rate of about 7.02 crashes per million vehicle-miles (acc/mvm), more than double the 3.49 average for MassDOT District 4. The high proportion of rear-end crashes is probably a product of two site features:
   - A fairly high number of turning movements causing abrupt braking, due to commercial land use (such as Enterprise Bank's driveway) and four intersecting streets (So. Highland Street crash experience was included in Site 3 below).
   - While signal-related rearend crashes were assigned to Sites 1 and 3 (signalized intersections), to the extent discernible in the crash reports, some of the remaining rearend crashes may well have been influenced by signal queuing.

3. Signalized Intersection
Gorham Street at Lowell Connector

This intersection is essentially a three-legged intersection with two Gorham Street approaches and one Lowell Connector approach. Actually, the residential driveway opposite the Lowell Connector terminus has two signal faces, but this is obviously not a significant operational feature.

The signal operates in two phases, alternately assigning right-of-way to the Lowell Connector and to Gorham Street. Pedestrian accommodations are limited to the east side, with no west side sidewalks and no crosswalks within the intersection.

Although there are two Gorham Street approaches, the predominant movements are between the north (Gorham Street) leg and the west (Lowell Connector) leg.

The 26 crashes at this signalized intersection yield a crash rate of about 1.26 crashes per million entering vehicles (acc/mev), well above the 0.73 average for signalized intersections in MassDOT District 4. The high proportion of angle crashes and sideswipe-same direction crashes is primarily driven by the geometry of the intersection for the Lowell Connector approach, where dual left-turn lanes feed into a single northbound receiving lane on Gorham Street. Although not as voluminous as some other type crashes, there is a long history of vehicle crashes into the property walls on the east side of Gorham Street.

This intersection crash tabulation includes South Highland Street, as it clearly shares an influence zone with the Lowell Connector. At least one crash in the data set involved a left-turning vehicle at South Highland Street.

4. Signalized Intersection
Gorham Street at Elm Street and Highland Street

This signalized intersection is a four-legged intersection, accommodating Elm Street to the east and Highland Street to the west.

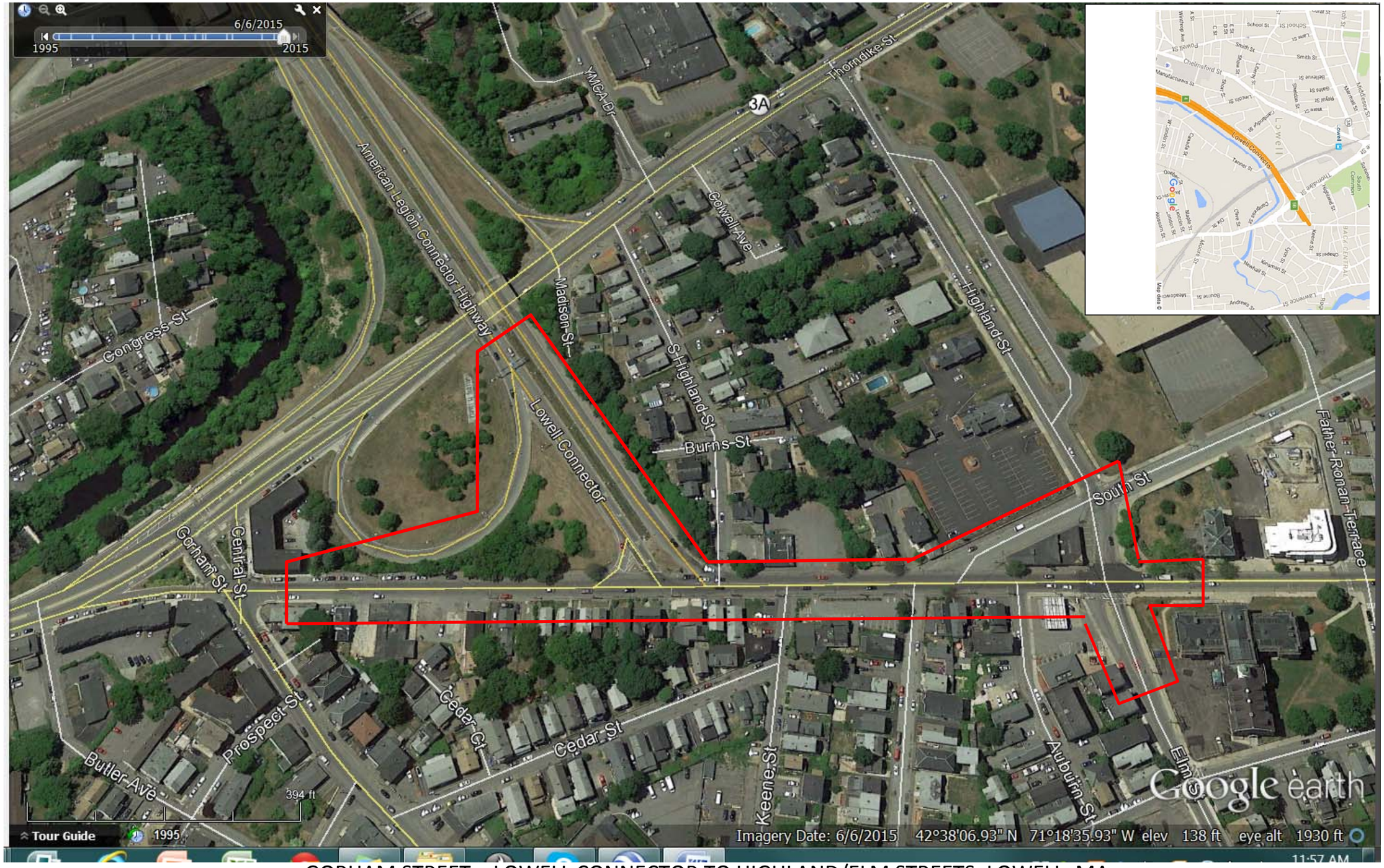
The Gorham Street northbound and southbound approaches are a single lane in width, approximately 16 feet including the shoulder. The Elm Street westbound approach has two 11-foot lanes. The Highland Street approach has recently been striped as two 10-foot lanes.

This signal operates with two vehicular phases, alternately assigning right-of-way to both Elm Street and Highland Street and to Gorham Street, There are pedestrian detectors (pushbuttons) and pedestrian heads serving crosswalks on all four approaches with an exclusive pedestrian phase when called. Field counts reflect a significant pedestrian volume (over 25 per hour during the PM peak) at this location, with the accumulated pedestrian calls contributing to vehicular delays.

Lane use designation is ambiguous for both the eastbound and westbound approaches to this intersection. Both Highland Street and Elm Street have two-lane approaches without signal "arrow" designations, implying both approach lanes can serve thru traffic, but both roads have only one receiving lane. The westbound receiving lane is wide enough (~20 ft.) to create the perception that it may function as two lanes.

The 29 crashes at this signalized intersection yield a crash rate of about 1.12 crashes per million entering vehicles (acc/mev), considerably higher than the 0.73 average for signalized intersections in MassDOT District 4. The high proportion of rear-end crashes is unsurprising for a signalized intersection. The equally high proportion of angle crashes is more significant, however. It could be an indication of east-west lane ambiguity or capacity issues triggering more aggressive behaviors (e.g., "running the yellow"). There were 3 reported strikes on the Elm Street median; 2 involving the traffic signal pole.

LOCUS MAP



GORHAM STREET – LOWELL CONNECTOR TO HIGHLAND/ELM STREETS, LOWELL, MA

PROJECT 604694

Audit Observations and Potential Safety Enhancements

Safety Issue 1: Pedestrian Accommodations

Projectwide, there is a consistent state of sidewalk facilities in disrepair, from concrete spalling and cracking to the presence of trees and bollards obstructing pedestrian paths. A few isolated sidewalk areas (for instance, near the E.N. Rogers school) have recently been resurfaced.

Image 1: Sidewalk in Disrepair

Marked crosswalks were present at some crossings, but missing at others. There has been a recent effort to install ADA accommodations at intersections, although the new facilities do not always comply with current standards. In many cases the sidewalk/pavement interface included an asphalt patch/ramp transition.

The City recently installed a perpendicular crosswalk across the South Street approach to Gorham Street. Because of the severe skew of the intersection, the west end of the crosswalk lies well upstream from the yield-controlled intersection, and crosses through the west parking lane of South Street.

Image 2: Disrupted west sidewalk

The sidewalk on the west side of Gorham Street is disrupted by the Lowell Connector, a four lane facility terminating at Gorham Street. Pedestrians on the west sidewalk approaching this intersection are obstructed without warning or readily available alternate route.

There is a crosswalk crossing Gorham Street just north of South Highland Street. This is essentially a mid-block crosswalk, but there is no signage supporting it. The Team believed this crosswalk may be a connection between a school bus dropoff point on the east side of Gorham Street and the residential area west of Gorham Street.

Image 3: Midblock Crosswalk

It should be noted that the sole pedestrian crash during the study period involved a skate-boarder, and likely is unrelated to these pedestrian deficiencies.

Enhancements

- Consider reconstruction of all sidewalks in order to meet ADA requirements and to provide a smooth walkable surface throughout.

- Provide signs to alert motorists of the presence of uncontrolled crosswalks on Gorham Street near Keene Street and on South Street near Gorham Street.

- Place "No Parking" signs in vicinity of crosswalk on both sides of South Street to remove the conflict. This will eliminate the need for pedestrians to enter the street outside the crosswalk, and will improve pedestrians' sightlines.

Safety Issue 2: Bicycle Accommodations

There is no designated space for bicycle travel with these road rights-of-way, although the paved surface could be striped for limited shoulders. A single partially obstructed sign near Keene Street advises northbound traffic that bikes may use the full lane. Field observations noted little bike traffic and field counts indicated less than 3 bicycles per hour during peak hours. The crash data indicates no bicycle-related crashes within the project study period in this study area. Nonetheless, reasonable efforts should be made for a bicycle friendly facility.

Image 4: Bike Signage

Enhancements

- Given the urban residential nature of the area, evaluate restriping Gorham Street to provide a 5-foot shoulder on both sides to accommodate bicyclists between the Lowell Connector and Elm Street.

- Use "share the road" designations between Central Street and Lowell Connector where the width does not allow a bike lane to improve driver awareness of the potential presence of bicycles in the roadway.

Safety Issue 3: Road Geometry

In general, the horizontal and vertical geometry of Gorham Street is relatively good. The segment of the Lowell Connector approaching Gorham Street is on a 2.3%± downgrade, which can affect braking, especially in adverse surface conditions.

The intersections within the project limits are of greater concern.

Gorham at Elm/Highland Streets

The intersection at Gorham and Elm/Highland Streets is constrained by adjacent land uses and existing street alignments.

Both Gorham Street approaches have only one lane in each direction resulting in long queues in both directions. Because of these single-lane approaches, these queues are exacerbated by the left-turning vehicles, at times leading to aggressive traffic moves like forming a second lane for thru vehicles to pass.

The Highland Street approach (eastbound) is a short (100') two-lane approach between South Street and Gorham Street. There is only one eastbound departure lane. There are no lane use designations and the left eastbound lane is aligned facing the island across on the Elm Street approach. The Elm Street approach (westbound) is two lanes with no lane use designation (the left lane acts as a de facto left turn lane).

There is a median island on Elm Street with no apparent function other than to accommodate a signal pole. The crosswalk does not pass through it. This signal pole has been the target of multiple vehicle hits. At the time of the site visit, a section of fence in front of the Courthouse had recently been knocked down.

Image 5:
Median Signal and Fence at Courthouse

Enhancements

- Consider eliminating the Elm Street median island, thus removing an obstacle.
- Retain the Elm Street median island, and reconfigure it to line up with the crosswalk, creating a pedestrian refuge area.
- Establish lane use designations to better define the available travel paths and remove ambiguous lane use. This will minimize abrupt lane changes and subsequent sideswipes for drivers.

Gorham and South Street

The intersection of South Street, a one-way southbound road, with Gorham Street is at a severe skew. This geometry requires that motorists entering the intersection from South Street look at a difficult angle (over left shoulder) for gaps in traffic.

Image 6: South Street Skew

Enhancements

- Evaluate realignment of the South Street approach to Gorham Street to ease the severe skew of the intersection and provide better sightlines for South Street traffic looking to enter the intersection.

Lowell Connector and Gorham Street

The signalized intersection of the Lowell Connector and Gorham Street has a number of geometric challenges. The Lowell Connector approach is a freeway segment terminating at a signalized intersection with a local road. This leads to approach speeds (*85th %-ile speed 35-36 mph*), that are excessive given that all traffic on this approach execute a nearly 60 degree left turn at the intersection. The intersection operation is dominated by this northbound movement of the two-lane Lowell Connector approach turning onto a single northbound lane on Gorham Street. The net result is a merging operation for vehicles while they are performing a turning movement through the intersection, where 5 of the 26 reported crashes occurred along this vehicle path.

The predominant southbound movement, from the single Gorham Street southbound lane right onto the Lowell Connector, should be virtually unimpeded, but is at times limited by the queuing of southbound thru traffic stopped at the signal, creating higher potential for rear-end crashes.

The intersection with South Highland Street is immediately adjacent to the Lowell Connector intersection, so the two intersections clearly influence each other. The mutual proximity of these intersections is a geometric issue that results in shared and compounded vehicle queues. The South Highland Street intersection is further discussed in Issue 5 below.

Enhancements - Evaluate alternatives for modifying the intersection to minimize northbound turning conflicts, improve southbound access to the Connector, improve the pedestrian experience at the intersection, and manage heavy volumes of traffic in limited space. Some of the alternatives include:

- Construct an exclusive right turn lane for the southbound approach to the Lowell Connector intersection, reducing queuing and the incidence of rearend crashes during periods of congestion.

- Reconfigure Lowell Connector intersection as a roundabout to eliminate queuing and merging during turning operations. Note that the merging would still occur but at a tangent areas of the designer's choosing.

- Realign the northbound Connector approach to form a right angle intersection with Gorham Street by moving this intersection about 200' further south. The southbound right-turning traffic could be afforded a turning lane. This alternative allows for more crosswalk design opportunities through the Lowell Connector intersection area.

- Realign the intersection to create a thru movement between the two high-volume legs, and align the southern segment of Gorham Street to intersect the thru legs at a perpendicular angle. This will reduce queuing.

Safety Issue 4: Signal Equipment and Operations

Traffic Signal hardware at both signalized intersections in this project is antiquated and in need of upgrades, including Emergency pre-emption equipment and programming.

A. Gorham Street at Highland Street and Elm Street


Image 7: Northbound Signal Heads

At the intersection of Gorham Street with Highland Street and Elm Street, it was noted that the near-side northbound signal is too close to the stopline to be effective. The mastarm should be on the far side of the intersection, better defining roadway and lane configuration. It was further noted that this head ambiguously displays a green "thru" arrow rather than a green ball, incorrectly implying that turning movements are not permitted. The other signal head supporting this approach is a pedestal-mounted head well left of the driver's path, near the lateral placement limit prescribed by the Manual on Uniform Traffic Control Devices. These signal head positions coupled with excessive queuing (discussed below) would appear to be key contributors to the 9 rearend northbound crashes reported for the 3-year study period.

The phasing for this signal system allows for an exclusive pedestrian phase. During busy pedestrian periods, this reduces the proportion of "green" time allotted to the four vehicular approaches to the intersection, causing excessive queuing on the northbound and southbound approaches.

The eastbound approach is now striped for two lanes. The City would like to provide an exclusive left turn lane here, but cannot fund the signal hardware modifications. Visibility of the traffic signal indications on this approach is a concern, as the Highland Street approach bends sharply at the South Street intersection.

B. Gorham Street at Lowell Connector

The southbound approach to this intersection is serviced by three signal heads. Two of these are "near-side" heads are much too close to the stopline to meet placement criteria. It was noted that one of the red lights on this approach was not operating at the time of the site visit.

There appear to be microwave detectors mounted on the signal poles, while evidence of pavement loops was also detected. It was suggested that loops may have been damaged during a recent road resurfacing, so the pole-mounted detectors were installed as a stopgap while awaiting loop replacement.

Enhancements

- All signal equipment should be replaced at both intersections. Specifically,
  - ✓ Replace all incandescent traffic signals with L.E.D. heads
  - ✓ Re-position pedestal-mounted signals at both signalized intersections on mastarms for better visibility.
  - ✓ Replace all pedestrian-related signal equipment (heads, pushbuttons, etc)
- Replace green "thru" arrow on northbound signal head at the intersection of Gorham Street with Elm Street, reducing the ambiguous information that the current arrow indication provides.
- Re-assign Eastbound Highland Street approach to allow only one thru lane (and one left-turn lane), as there is only one existing receiving lane on Elm Street. This will reduce eastbound sideswipe and rearend crashes and provide better conflict recognition.

Safety Issue 5: Intersection Operations

A. South Highland Street at Gorham Street

This "T" intersection is just north of the Lowell Connector. This intersection can be difficult to navigate for a number of reasons. For eastbound traffic exiting South Highland Street, there is insufficient sight distance to the north due to a building, set at the back of the sidewalk. The merging traffic from the south makes gaps difficult to recognize. For northbound traffic entering South Highland Street, the likely stop required to await a sufficient southbound gap for a left turn occurs within the merge area for northbound traffic coming from the 2-lane Lowell Connector approach to this single northbound lane. This issue may well contribute to the high rate of rear-end and sideswipe crashes in this area.

There is a good amount of vegetation between South Highland Street and the Lowell Connector, affecting sightlines for eastbound South Highland Street traffic, although the crash data does not reflect this.

If improvements to the southbound movement to the Lowell Connector affect the west curbline of Gorham Street, the sightlines may well be further compromised. It has been noted that the western end of South Highland Street at Thorndike Street has a turning limitation (no left turn westbound).

Image 8:
Lowell Connector & So. Highland Street

B. Lowell Connector at Gorham Street

At this intersection, a four-lane freeway segment of the Lowell Connector terminates at Gorham Street, a two-lane city street.

Heavy northbound traffic from the Connector's two left-turning approach lanes is required to merge to be accommodated by Gorham Street's single northbound travel lane. The abrupt termination of the freeway with its higher speeds and heavy volumes forced to merge through a turning movement onto a local city street contributes substantially to the high crash rates. Frequent crashes involving rearend and sideswipes have been reported, as have vehicle impacts with signs, poles and property walls on the east side of Gorham Street, the "outside" of the curved vehicular path.

Image 9: Property Wall Hit

Two homes on the east side of the roadway of Gorham Street, opposite the Lowell Connector,(#506 and #512) have guardrails installed along the curbline. Their presence further supports a past history of vehicle encroachments to the sidewalk, utility poles, etc.

The pavement condition for the Lowell Connector approach lanes is poor, displaying signs of shoving and loss of texture, presumably due to excessive braking. This could be a contributor to the rearend crashes documented for this approach.

<u>Enhancements</u>

Gorham Street at Lowell Connector & South Highland Street

- Restripe the northbound lane of Gorham Street north of the Lowell Connector to better facilitate the merge by shifting the double yellow centerline westward north of the intersection. A longer well-defined merge zone will reduce sideswipe and rearend crashes

- Extend the guardrail segments along the curbline opposite the Lowell Connector northward, along the turning and merging areas of the intersection to redirect errant vehicles from the sidewalk and private retaining walls. While not an ideal application of highway guard, it reduces pedestrian crash risk and protects the retaining walls at the back of the sidewalk

- Resurface the northbound Lowell Connector approach with a coarse-graded superpave surface course (or alternative surface course to be determined) to improve slowing/stopping performance. Current surface is smooth, and almost 30% of reported crashes occurred under rain/snow/ice conditions

- Implement positive pedestrian barriers to eliminate pedestrian encroachment on the Lowell Connector (south of So. Highland Street and south of the Connector). This is not indicated by a pedestrian crash history; it is recommended nonetheless.

- Consider restriction on left turns into South Highland Street. This will reduce the occurrence of stopped (turning) vehicles impeding northbound traffic on Gorham Street, reducing rearend crashes.

- Consider restriction on left turns out of South Highland Street. This will reduce the risk of angle crashes with southbound traffic due to limited sight distance (due to the existing Lounge building), as well as with northbound traffic where gaps are difficult to perceive due to the merging traffic.

- Evaluate comprehensive changes/realignment of the intersection to address all or most of the above stated issues.

- Clear vegetation on west side of Gorham Street, between South Highland Street and the Lowell Connector.

Safety Issue 6: Signing and Pavement Marking

Throughout the project area, there is a continuing theme of missing or badly worn signs and pavement markings. Stop bars were missing at the side streets. Many signs are mounted on utility poles, and thus aren't necessarily in positions where they can be most effective.

On the date of the Road Safety Audit, much of the intersection pavement marking had been repainted. The following specific deficiencies were observed:

- South Street at Highland: Southbound stop sign needs to move closer to the intersection.
- Auburn Street: Stop sign missing.
- Keene Street: Stop sign and stop line missing.
- South Highland Street/Keene Street: Crosswalk has no supporting signage.
- Lowell Connector: Object marker on east side has private sign attached to it.
- Lowell Connector: The northbound No-Left-Turn Sign is not legible.

Enhancements

- All regulatory/warning/lane use signs (missing and existing) in the project area should be replaced.
- Move the southbound stop sign at the South Street / Highland Street intersection closer to the actual intersection, where it will better protect the crosswalk.
- Replace the Yield sign at the South Street approach to Gorham Street with a Stop bar and Stop sign, due to the awkward angle and limited sight distance for viewing southbound Gorham Street Traffic.
- Place crosswalk signs with plaques in support of the South Street crosswalk near Gorham Street.
- Place crosswalk signs with plaques in support of the Gorham Street crosswalk just south of Keene Street.
- Replace the missing Stop signs at Keene Street and at Auburn Street.
- Consider striping and signing the left lanes of the Elm Street and Highland Street approaches to be exclusive left turn lanes, regardless of signal phasing.
- Replace worn pavement markings throughout.
- Consider enhanced signage and pavement markings on the Lowell Connector approach to communicate the transition (freeway to City Street) to drivers. Currently there is only a small green-background ground-mounted sign. This might include flashing warning devices, pavement text (i.e., “STOP AHEAD”), and different pavement textures.
- Signing should be supplemented with pavement markings (with reflectors) to forewarn of and upcoming turning movement. These measures can reduce northbound rearend as well as speed-related crashes.

Summary of Road Safety Audit

Following the site walk, participants returned to the meeting room to review the safety issues identified on the walk and to recommend potential countermeasures. Observations were reviewed and in some cases given context by those familiar with specific aspects of the project.

The section of Gorham Street north of the Lowell Connector is burdened by very heavy peak hour traffic volumes coming and going to the Connector that create congestion and lead to aggressive driving and a higher crash rate.

All potential improvements have been categorized by the following time frames: short-term, intermediate, and long-term.

Enhancements were assigned to a cost category, as identified in Table 2 below.

Table 2: Estimated Time Frame and Costs Breakdown

Safety Payoff		**Time Frame**		**Costs**	
Low	May Reduce Crashes	Short-Term	<1 Year	Low	<$10,000
Medium	Will Probably Reduce Crashes	Mid-Term	1-3 Years	Medium	$10,001-$50,000
High	Certain to Reduce Crashes	Long-Term	>3 Years	High	>$50,000

In general there are many safety related improvements that need to be made ranging from the easy to implement such as replacing signs, realignment and supplementing pavement markings, and some signal repairs; the medium cost improvements such replacing entire signal systems and bringing sidewalks into ADA compliance; and the more comprehensive intersection improvements at the Lowell Connector and Gorham Street. Recommendations for improving safety are summarized in Table 3 and are categorized based on estimated safety payoff (estimate of the safety benefit), time frame and cost for implementation.

It is understood that some of these recommendations conflict with one another. Further evaluation is required during the Functional Design Report phase to focus on the best course of action.

Table 3: Potential Safety Enhancement Summary

I.D.	Safety Issue	Potential Safety Enhancement	Safety Payoff	Time Frame	Cost	Responsible Agency
	South Street at Highland Street					
1	Signing and Pavement Marking	Move the southbound stop sign closer to the intersection.	Low	Short	Low	City of Lowell
	Gorham Street at Elm Street and Highland Street					
2	Signal Equipment & Operations	All signal equipment should be replaced, with new signals being mastarm-mounted.	Medium	Medium	High	MassDOT
3	Signal Operations & Operations	Replace green “thru” arrow on northbound signal head at the intersection of Gorham Street with Elm Street	Medium	Short	Low	City of Lowell
4	Signal Operations & Operations	Replace all incandescent traffic signals with L.E.D. heads	Low	Short	Medium	City of Lowell
5	Road Geometry	Reconfigure Elm Street median island, to provide pedestrian refuge and better protect signal pole.	Medium	Medium	Medium	MassDOT
6	Signing and Pavement Marking	Stripe and sign the left lanes of the Elm Street and Highland Street approaches to be exclusive left turn lanes, regardless of signal phasing.	Low	Short	Low	City of Lowell

I.D.	Safety Issue	Potential Safety Enhancement	Safety Payoff	Time Frame	Cost	Responsible Agency
	Gorham Street at South Street					
7	Signing and Pavement Marking	Replace Missing Yield Sign near Gorham Street intersection with a stop bar and stop sign.	Low	Short	Low	City of Lowell
8	Signing and Pavement Marking	Place Crosswalk signs with plaques at crosswalk. Also place no parking signs near the west end of crosswalk.	Low	Short	Low	City of Lowell
9	Road Geometry	Realign the South Street approach to Gorham Street	Low	Medium	Medium	MassDOT
	Gorham Street at South Highland Street					
10	Pedestrian Accommodations	Provide signs to alert motorists of the presence of a crosswalk at Keene Street / South Highland Street	Medium	Short	Low	City of Lowell
11	Intersection Operations	Consider prohibiting eastbound left turns from South Highland Street	High	Short	Low	City of Lowell
12	Intersection Operations	Clear vegetation on west side of Gorham Street, between South Highland Street and the Lowell Connector.	Low	Short	Low	MassDOT

I.D.	Safety Issue	Potential Safety Enhancement	Safety Payoff	Time Frame	Cost	Responsible Agency
	Gorham Street at Lowell Connector					
	Comprehensive Intersection Improvement Alternatives					
13	Road Geometry	Construct an exclusive right turn lane for the southbound approach to the Lowell Connector intersection	Medium	Medium	High	MassDOT
14	Road Geometry	Reconfigure Lowell Connector intersection as a roundabout.	High	Long	High	MassDOT
15	Road Geometry	Reconfigure Lowell Connector intersection to establish north and west legs as “thru” movement.	High	Long	High	MassDOT
16	Road Geometry	Re-align Lowell Connector intersection to eliminate skew.	Medium	Long	High	MassDOT
	Improvements to Individual Elements in the Intersection					
17	Signal Operations & Operations	All signal equipment should be replaced, with new signals being mastarm-mounted.	Medium	Medium	High	MassDOT
18	Signal Operations & Operations	Replace all incandescent traffic signals with L.E.D. heads	Low	Short	Medium	MassDOT

I.D.	Safety Issue	Potential Safety Enhancement	Safety Payoff	Time Frame	Cost	Responsible Agency
19	Intersection Operations	Restripe the northbound lane of Gorham Street north of the Lowell Connector to better facilitate the merge.	Medium	Short	Low	MassDOT
20	Intersection Operations	Extend the guardrail segments along the curbline opposite the Lowell Connector northward	Low	Short	Low	MassDOT
21	Intersection Operations	Resurface the northbound Lowell Connector approach	Medium	Medium	Medium	MassDOT
22	Intersection Operations	Improve signing on the Lowell Connector approach to establish more positive driver expectancy for the signalized intersection	Medium	Medium	Low	MassDOT
23	Intersection Operations	Implement positive pedestrian barriers to eliminate pedestrian encroachment on the Lowell Connector	Low	Medium	Low	MassDOT
	Project-wide					
24	Pedestrian Accommodations	Reconstruct all sidewalks to ADA requirements	Low	Medium	High	MassDOT
25	Bicycle Accommodations	Restripe Gorham Street to provide a 5-foot shoulder on both sides	Medium	Short	Low	City of Lowell

I.D.	Safety Issue	Potential Safety Enhancement	Safety Payoff	Time Frame	Cost	Responsible Agency
26	Bicycle Accommodations	Use “share the road” between Central Street and Lowell Connector	Low	Short	Low	City of Lowell
27	Signing and Pavement Marking	All signs in the project area should be replaced.	Medium	Medium	Low	MassDOT
28	Signing and Pavement Marking	Replace the missing Stop signs at Keene Street and at Auburn Street.	Low	Short	Low	City of Lowell

Appendix A. RSA Meeting Agenda

Road Safety Audit

Gorham Street from Lowell Connector to Elm Street

Meeting Location: E. N. Rogers School, Room 116
43 Highland Avenue, Lowell MA (northwest end of project area)
June 28th, 2016
10:00 AM – 12:00 noon

Type of meeting:	**High Crash Location – Road Safety Audit**
Attendees:	**Invited Participants to Comprise a Multidisciplinary Team**
Please bring:	**Safety Gear, Vest, as agency may require.**

10:00 - 10:10 AM	**Welcome and Introductions**
10:10 - 10:30 AM	**Review of Site Specific Material** • Project History • Crash, Speed & Volume Summaries– provided in advance • Existing Geometries and Conditions
10:30 - 11:30 AM	**Visit the Site** • A Short Walk to Gorham Street • As a group, identify areas for improvement
11:30 AM - Noon	**Post Visit Discussion / Completion of RSA** • Discuss observations and finalize findings • Discuss potential improvements and finalize recommendations
12:00 Noon	**Adjourn for the Day – but the RSA has not ended**

INSTRUCTIONS FOR PARTICIPANTS:

- ***Before*** **the June 28 Meeting**
  Participants are encouraged to drive through these two intersections and complete/consider elements on the RSA Prompt List with a focus on safety.

- ***At*** **the June 28 Meeting**
  All participants will be actively involved in the process throughout. Participants are encouraged to come with thoughts and ideas, but are reminded that the synergy that develops and respect for others' opinions are key elements to the success of the overall RSA process.

- ***After*** **the June 28 Meeting**
  Participants will be asked to comment and respond to the document materials

Appendix B. RSA Audit Team Contact List

Participating Audit Team Members

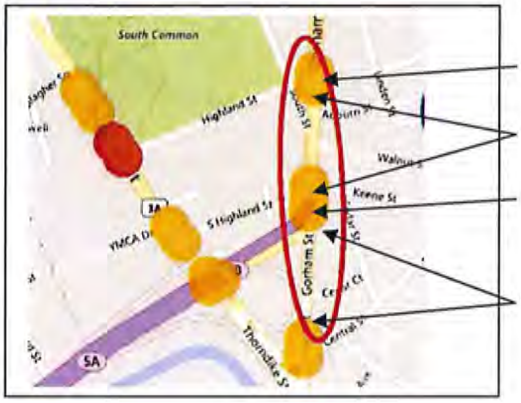
Date: June 28,2016 **Location**: Gorham Street, Lowell, Massachusetts

Audit Team Members	Agency/Affiliation	Email Address	Phone Number
Carrie Lavallee	MassDOT Project Manager	Carrie.Lavallee@state.ma.us	(857) 368-9343
John Gregg	MassDOT District Traffic Engineer	John.Gregg@state.ma.us	(978) 641-8485
Tim Roberts	MassDOT District Traffic Engineer	Timothy.Roberts@state.ma.us	
Lisa Schletzbaum	MassDOT Safety Management Unit	Lisa.Schletzbaum@state.ma.us	(857) 368-9634
Adam Prichard	MassDOT	Adam.Prichard@state.ma.us	
Brendan Mullan	MassDOT	Brendan.Mullan@state.ma.us	
Lisa DeMeo	Lowell City Engineer (DPW)	ldemeo@lowellma.gov	(978) 674-4070
Mark Buckley	Lowell Police Department	mbuckley@lowellma.gov	(978) 937-3200
Phillip Charron	Lowell Fire Department	pcharron@lowellma.gov	(978) 459-5554
Nicolás H. Bosonetto	Lowell Transportation Engineer (Planning Dept.)	nbosonetto@lowellma.gov	(978) 674-1417
Sidney Liang	Lowell Bicycle & Pedestrian Coordinator	SLiang@lowellma.gov	(978) 746-1420
Tim Connors	Mass State Police - Station A-1, Andover	Msp0800@pol.state.ma.us	(978) 475-3800
Justin Howard	Northern Middlesex COG	jhoward@nmcog.org	(978) 454-8021 ext. 121
David Freeman	Project Manager CDR Maguire	David.Freeman@cdrmaguire.com	(401) 437-5613
Jim Coogan	Traffic Engineer CDR Maguire	james.coogan@cdrmaguire.com	(401) 437-5609

Appendix C. Detailed Crash Data

Intersection Improvements for Lowell Connector at Gorham Street - Accident Summary
Project 604694

COLLISION-TYPE TABULATION



Locations

Site 1: Intersection of Gorham Street with Highland and Elm Streets

Site 2: Gorham Street from Elm Street to Lowell Connector

Site 3: Intersection of Gorham Street with Lowell Connector (including South Highland Street intersection)

Site 4: Gorham Street from Lowell Connector to Central Street

Distribution – Location and Type

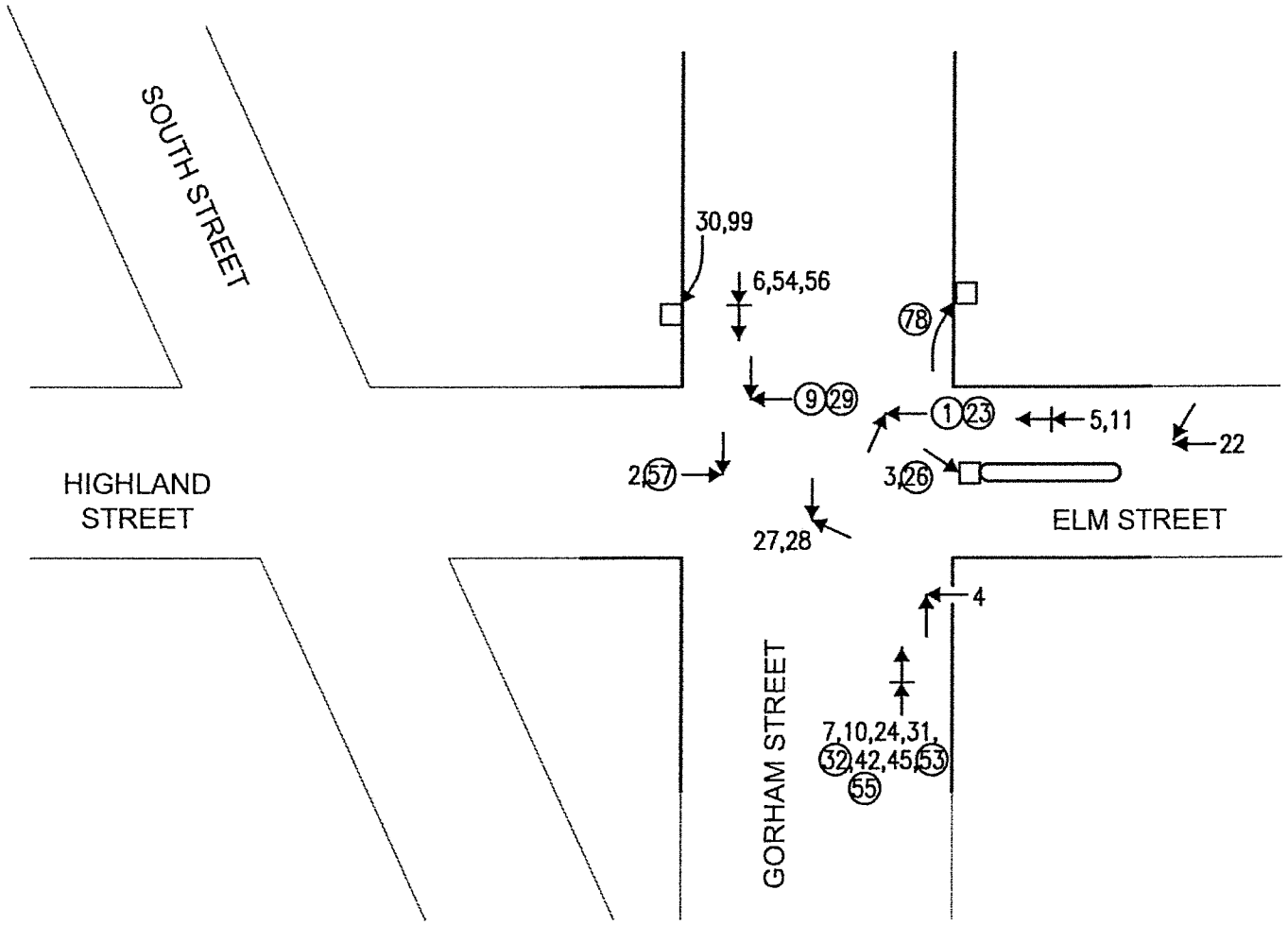
	Site 1	Site 2	Site 3	Site 4
Total Crashes	29	18	26	1
Crash Rate (acc/mev)	1.12		1.26	
Crash Rate (acc/mvm)		7.02		1.85
District Average Rate	.73	3.49	.73	3.49
Rear-end	11 (38%)	8 (44%)	8 (31%)	---
Angle	9 (31%)	8 (44%)	10 (38%)	---
Sideswipe Same Direction	---	1 (6%)	4 (15%)	1 (100%)
Single Vehicle	5 (17%)	1 (6%)	3 (12%)	---
Head-on	1 (4%)	---	---	---
Unknown	3 (10%)	---	1 (4%)	---

CDR MAGUIRE

LOWELL, MA
GORHAM STREET AT HIGHLAND/ELM STREETS

COLLISION DIAGRAM

TIME PERIOD ANALYZED: 20XX–20XX
SOURCE OF CRASH REPORTS: ------
DATE PREPARED: ------ XXXX
PREPARED BY: JWC



SYMBOLS	TYPES OF CRASH	SEVERITY
Pedestrian	Head On	XX = Accident I.D. Property Damage Only
Fixed Object	Rear End	(XX) = Accident I.D. Injury
Traffic Flow	Angle	
	Turning Movement	
	Sideswipe	

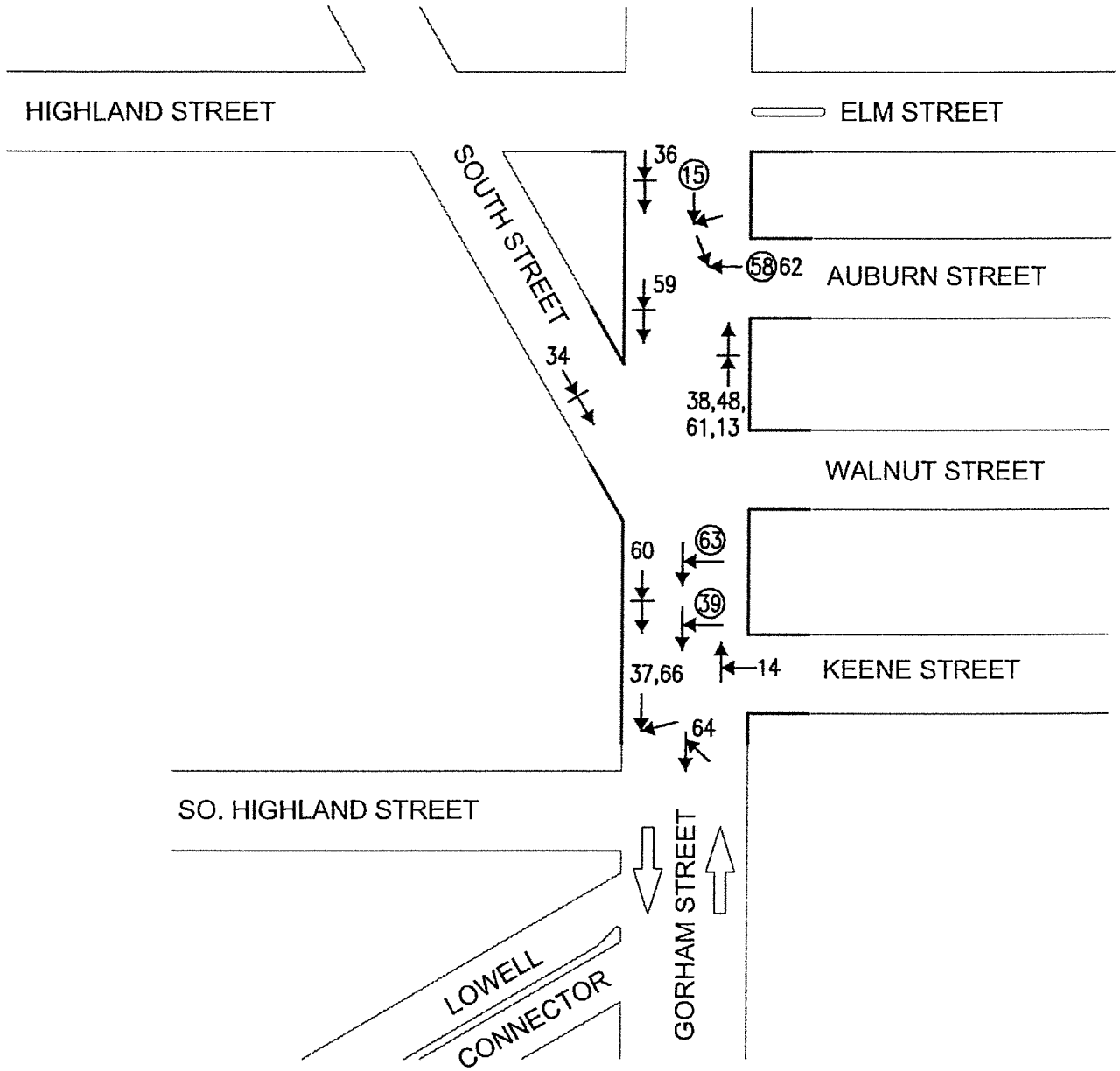
N

CDR MAGUIRE

LOWELL, MA
GORHAM STREET
FROM LOWELL CONNECTOR TO ELM STREET

COLLISION DIAGRAM

TIME PERIOD ANALYZED: 20XX–20XX
SOURCE OF CRASH REPORTS: ------
DATE PREPARED: ------ XXXX
PREPARED BY: JWC



SYMBOLS	TYPES OF CRASH	SEVERITY
Pedestrian	Head On	XX = Accident I.D. Property Damage Only
Fixed Object	Rear End	(XX) = Accident I.D. Injury
Traffic Flow	Angle	
	Turning Movement	
	Sideswipe	

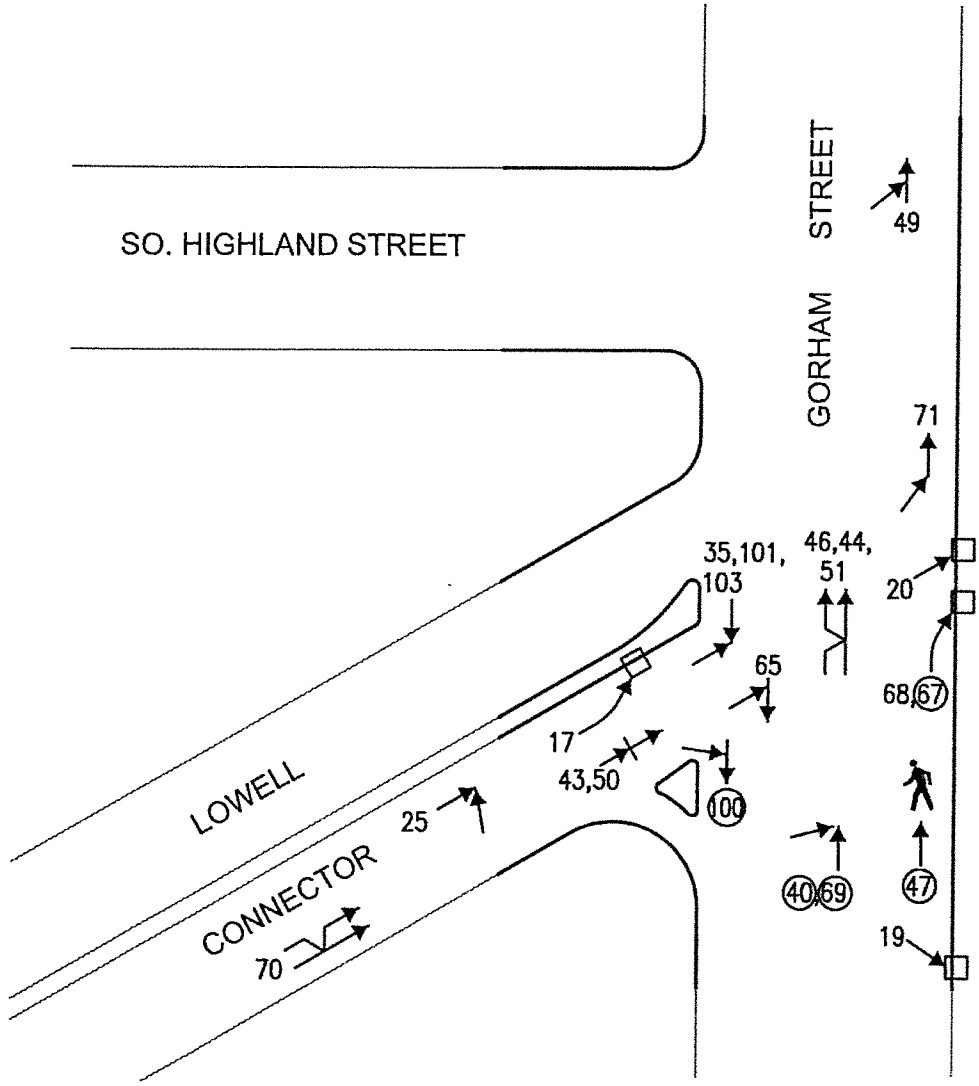
N

CDR MAGUIRE

LOWELL, MA
GORHAM STREET
AT LOWELL CONNECTOR

COLLISION DIAGRAM

TIME PERIOD ANALYZED: 20XX–20XX
SOURCE OF CRASH REPORTS: ------
DATE PREPARED: ------ XXXX
PREPARED BY: JWC



SYMBOLS	TYPES OF CRASH	SEVERITY
Pedestrian	Head On	XX = Accident I.D. Property Damage Only
Fixed Object	Rear End	(XX) = Accident I.D. Injury
Traffic Flow	Angle	
	Turning Movement	
	Sideswipe	

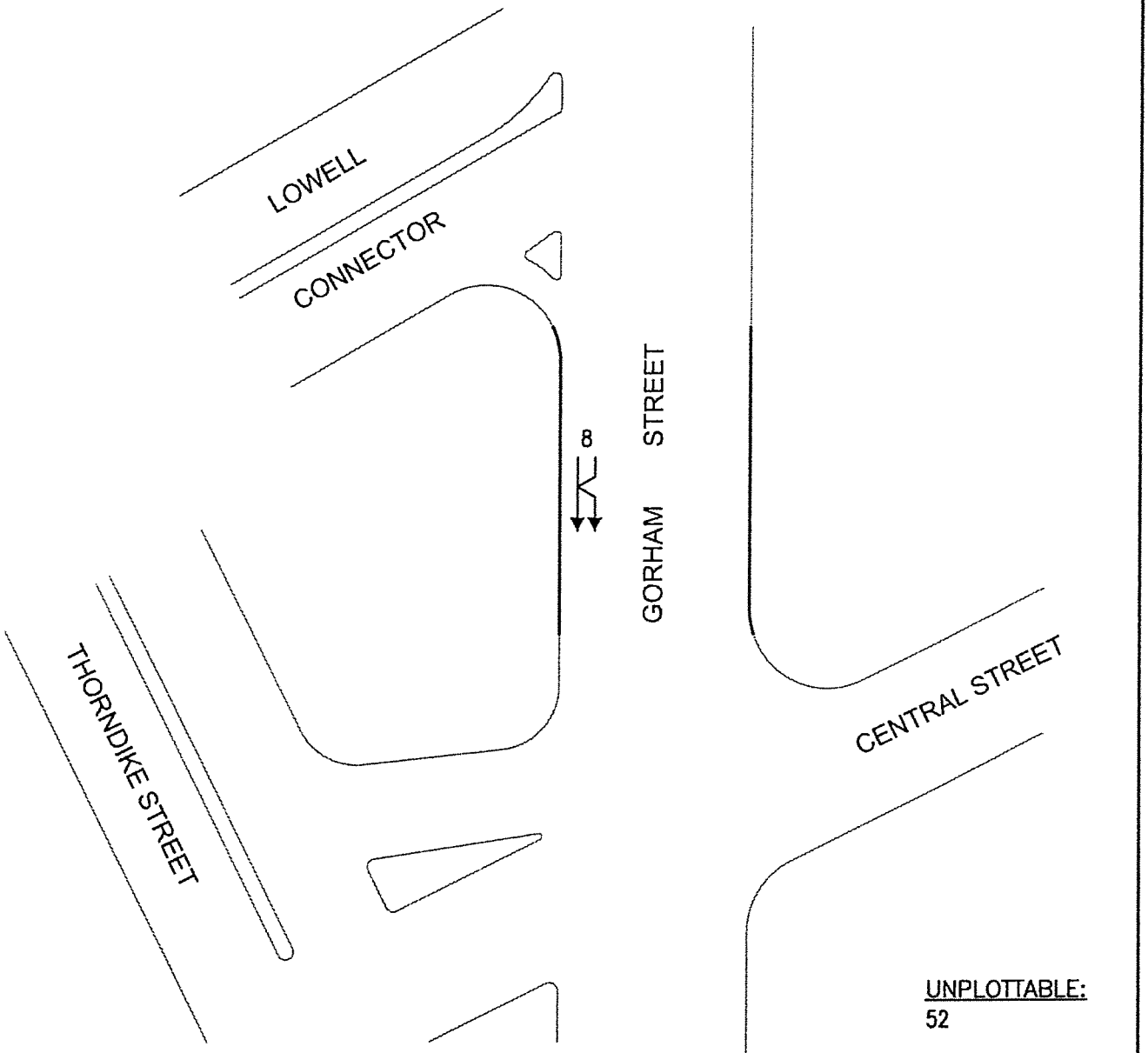
N

CDR MAGUIRE

LOWELL, MA
GORHAM STREET
FROM LOWELL CONNECTOR TO CENTRAL STREET

COLLISION DIAGRAM

TIME PERIOD ANALYZED: 20XX–20XX
SOURCE OF CRASH REPORTS: ------
DATE PREPARED: ------ XXXX
PREPARED BY: JWC



UNPLOTTABLE:
52

SYMBOLS	TYPES OF CRASH	SEVERITY
Pedestrian	Head On	XX = Accident I.D. Property Damage Only
Fixed Object	Rear End	(XX) = Accident I.D. Injury
Traffic Flow	Angle	
	Turning Movement	
	Sideswipe	

N

CDR MAGUIRE

massDOT Massachusetts Department of Transportation Highway Division

Intersection Improvements for Lowell Connector at Gorham Street -Project 604694 - Accident Summary

Crash Number	CDR Ref #	CDR Location	Crash Date	Crash Severity	Number of NonFatal Injuries	Number of Fatal Injuries	Number of Vehicles	Manner of Collision	Vehicle Travel Directions	Crash Time	Road Surface	Ambient Light	Weather Condition	Roadway	Near Intersection Roadway	Traffic Control Device Type	X	Y
2011																		
2694240	1	1	1/14/2011	Non-fatal injury	1	0	2	Angle	V1:S / V2:N	5:45 AM	Snow	Dark - lighted roadway	Clear	GORHAM STREET / ELM STREET		Traffic control signal	215672.6876	931841.7498
2713687	2	1	3/12/2011	Property damage only (none injured)	0	0	2	Single vehicle crash	V1:E / V2:S	12:00 AM	Wet	Dark - lighted roadway	Clear	GORHAM STREET / HIGHLAND STREET		Traffic control signal	215672.6876	931841.7498
2712963	3	1	3/28/2011	Property damage only (none injured)	0	0	1	Not reported	V1:S	8:19 AM	Not reported	Not reported	Not Reported	GORHAM STREET / ELM STREET		Not reported	215672.6876	931841.7498
2716553	4	1	4/4/2011	Property damage only (none injured)	0	0	2	Angle	V1:B / V2:B	12:45 PM	Wet	Daylight	Rain/Rain	GORHAM STREET / ELM STREET		No controls	215672.6876	931841.7498
2727869	5	1	5/24/2011	Property damage only (none injured)	0	0	2	Unknown	V1:B / V2:B	1:15 PM	Dry	Daylight	Clear	ELM STREET / GORHAM STREET		Traffic control signal	215672.6876	931841.7498
2743535	6	1	7/18/2011	Property damage only (none injured)	0	0	2	Rear-end	V1:S / V2:S	11:00 AM	Dry	Daylight	Cloudy/Cloudy	GORHAM STREET / ELM STREET		Traffic control signal	215672.6876	931841.7498
2790585	7	1	10/2/2011	Not Reported	0	0	2	Rear-end	V1:B / V2:B	6:33 PM	Wet	Dusk	Cloudy/Rain	GORHAM STREET / ELM STREET		No controls	215672.6876	931841.7498
2809931	8	1	10/24/2011	Property damage only (none injured)	0	0	2	Angle	V1:B / V2:B	5:15 PM	Dry	Daylight	Clear/Clear	GORHAM STREET		No controls	215662.8786	931491.7483
2809557	9	1	10/30/2011	Non-fatal injury	1	0	2	Angle	V1:B / V2:B	12:50 PM	Wet	Daylight	Clear	GORHAM STREET / ELM STREET / HIGHLAND STREET		Traffic control signal	215672.6876	931841.7498
2792630	10	1	10/31/2011	Property damage only (none injured)	0	0	2	Rear-end	V1:N / V2:N	6:45 AM	Dry	Dawn	Clear	GORHAM STREET / ELM STREET		Traffic control signal	215672.6876	931841.7498
2959540	11	1	12/10/2011	Property damage only (none injured)	0	0	2	Rear-end	V1:B / V2:B	11:40 AM	Dry	Daylight	Cloudy	ELM STREET / GORHAM STREET		Traffic control signal	215672.6876	931841.7498
2731685	12	2	6/8/2011	Not Reported	0	0	2	Angle	V1:B / V2:B	5:12 AM	Dry	Dark - lighted roadway	Clear/Clear	GORHAM STREET / AUBURN STREET		No controls	215671.3594	931799.0623
2736533	13	2	6/15/2011	Property damage only (none injured)	0	0	2	Rear-end	V1:N / V2:N	4:05 PM	Dry	Daylight	Cloudy	GORHAM STREET	AUBURN STREET	No controls	215671.3594	931799.0623
2737103	14	2	6/18/2011	Property damage only (none injured)	0	0	2	Angle	V1:B / V2:B	9:44 PM	Dry	Dark - lighted roadway	Clear	KEENE STREET / GORHAM STREET /		Not reported	215668.0939	931688.1877
2748380	15	2	7/28/2011	Non-fatal injury	1	0	2	Angle	V1:S / V2:S	7:00 AM	Ice	Daylight	Clear	GORHAM STREET / SOUTH STREET		No controls	215669.828	931749.3123
2704411	16	3	1/2/2011	Property damage only (none injured)	0	0	2	Angle	V1:N / V2:S	1:09 PM	Wet	Daylight	Cloudy	LOWELL CONNECTOR / GORHAM STREET		Traffic control signal	215666.903	931660.4685
3114256	17	3	6/25/2011	Not Reported	0	0	2	Single vehicle crash	V1:E / V2:B	12:00 AM	Wet	Dark - lighted roadway	Rain	LOWELL CONNECTOR / GORHAM STREET		Traffic control signal	215666.903	931660.4685
2744452	18	3	7/20/2011	Not Reported	0	0	2	Rear-end	V1:B / V2:B	5:30 PM	Dry	Daylight	Clear	GORHAM STREET / LOWELL CONNECTOR		Traffic control signal	215666.903	931660.4685
2761111	19	3	9/2/2011	Property damage only (none injured)	0	0	1	Single vehicle crash	V1:N	3:30 AM	Dry	Dark - lighted roadway	Clear	GORHAM STREET		Stop signs	215666.7363	931651.6461
3129497	20	3	9/21/2011	Not Reported	0	0	1	Rear-end	V1:B	9:40 PM	Dry	Dark - lighted roadway	Clear	GORHAM STREET		Traffic control signal	215666.7077	931650.1301
2881540	21	3	12/31/2011	Property damage only (none injured)	0	0	2	Rear-end	V1:E / V2:E	8:45 AM	Wet	Daylight	Rain/Cloudy	LOWELL CONNECTOR / GORHAM STREET		Traffic control signal	215666.903	931660.4685
2796539	22	1	10/23/2011	Property damage only (none injured)	0	0	2	Angle	V1:W / V2:W	6:47 PM	Dry	Dark - lighted roadway	Clear	ELM STREET	GORHAM STREET	No controls	215672.6876	931841.7498

LOCATION KEY

1 = Gorham @ Elm Street
2 = Gorham St Segment Between
3 = Gorham @ Lowell Connector
4 = Gorham Street just south of Lowell Connector

CDR MAGUIRE

massDOT Massachusetts Department of Transportation Highway Division

Intersection Improvements for Lowell Connector at Gorham Street -Project 604694 - Accident Summary

Crash Number	CDR Ref #	CDR Location	Crash Date	Crash Severity	Number of NonFatal Injuries	Number of Fatal Injuries	Number of Vehicles	Manner of Collision	Vehicle Travel Directions	Crash Time	Road Surface	Ambient Light	Weather Condition	Roadway	Near Intersection Roadway	Traffic Control Device Type	X	Y
2012																		
3057962	24	1	2/11/2012	Not Reported	0	0	2	Rear-end	V1:N / V2:N	12:00 AM	Dry	Daylight	Clear	GORHAM STREET / ELM STREET		Traffic control signal	215672.6876	931841.7498
3249593	30	1	7/9/2012	Unknown	0	0	1	Single vehicle crash	V1:S	3:14 AM	Dry	Dark - lighted roadway	Clear	GORHAM STREET / ELM STREET		Traffic control signal	215672.6876	931841.7498
3268198	31	1	8/16/2012	Property damage only (none injured)	0	0	2	Rear-end	V1:N / V2:N	8:45 AM	Dry	Daylight	Clear	GORHAM STREET / ELM STREET		Traffic control signal	215672.6876	931841.7498
3110130	34	2	4/9/2012	Property damage only (none injured)	0	0	2	Rear-end	V1:B / V2:B	4:36 PM	Dry	Daylight	Clear/Clear	GORHAM STREET / SOUTH STREET		Not reported	215669.828	931749.3123
3134242	35	2	4/17/2012	Property damage only (none injured)	0	0	2	Rear-end	V1:N / V2:N	3:38 PM	Dry	Daylight	Clear	GORHAM STREET / AUBURN STREET		Traffic control signal	215671.3594	931799.0623
3146132	36	2	5/1/2012	Property damage only (none injured)	0	0	2	Rear-end	V1:S / V2:S	4:40 PM	Wet	Daylight	Cloudy/Rain	GORHAM STREET / AUBURN STREET		No controls	215671.3594	931799.0623
3292297	37	2	10/12/2012	Property damage only (none injured)	0	0	2	Angle	V1:S / V2:S	8:55 AM	Dry	Daylight	Clear	GORHAM STREET / KEENE STREET		No controls	215668.0939	931688.1877
3340915	39	2	11/5/2012	Property damage only (none injured)	0	0	1	Single vehicle crash	V1:W	12:40 PM	Dry	Daylight	Clear	GORHAM STREET / KEENE STREET		No controls	215668.0939	931688.1877
2990422	40	3	1/16/2012	Non-fatal injury	2	0	2	Angle	V1:B / V2:B	11:15 PM	Snow	Dark - lighted roadway	Snow/Blowing sand, snow	LOWELL CONNECTOR / GORHAM STREET		Traffic control signal	215666.903	931660.4685
3027842	41	3	2/9/2012	Non-fatal injury	2	0	2	Rear-end	V1:B / V2:B	1:20 PM	Dry	Daylight	Clear	GORHAM STREET	LOWELL CONNECTOR	No controls	215666.903	931660.4685
3268502	45	3	8/16/2012	Property damage only (none injured)	0	0	1	Single vehicle crash	V1:E	7:00 AM	Wet	Daylight	Rain	GORHAM STREET		Traffic control signal	215666.7521	931652.4811
3286871	46	3	9/5/2012	Property damage only (none injured)	0	0	2	Sideswipe, same direction	V1:N / V2:N	3:50 PM	Dry	Daylight	Clear	LOWELL CONNECTOR / GORHAM STREET		Traffic control signal	215666.903	931660.4685
3284540	47	3	9/13/2012	Non-fatal injury	1	0	1	Not reported	V1:B	7:40 AM	Dry	Daylight	Clear	GORHAM STREET / LOWELL CONNECTOR		No controls	215666.903	931660.4685
3329331	49	3	11/11/2012	Property damage only (none injured)	0	0	2	Angle	V1:B / V2:B	9:08 PM	Dry	Dark - lighted roadway	Clear	GORHAM STREET	S. HIGHLAND STREET	No controls	215666.903	931660.4685
3349407	50	3	12/6/2012	Property damage only (none injured)	0	0	2	Rear-end	V1:B / V2:B	12:06 PM	Dry	Daylight	Clear/Clear	GORHAM STREET / LOWELL CONNECTOR		Traffic control signal	215666.903	931660.4685
3360221	51	3	12/13/2012	Property damage only (none injured)	0	0	2	Sideswipe, same direction	V1:B / V2:B	10:36 PM	Dry	Dark - lighted roadway	Clear/Clear	GORHAM STREET / SOUTH HIGHLAND STREET		No controls	215666.903	931660.4685
3017738	52	4	1/28/2012	Not Reported	0	0	2	Sideswipe, same direction	V1:N / V2:B	12:00 AM	Dry	Daylight	Clear/Clear	GORHAM STREET		No controls	215661.7581	931456.1689

LOCATION KEY

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CDR MAGUIRE

massDOT Massachusetts Department of Transportation Highway Division

Intersection Improvements for Lowell Connector at Gorham Street -Project 604694 - Accident Summary

Crash Number	CDR Ref #	CDR Location	Crash Date	Crash Severity	Number of NonFatal Injuries	Number of Fatal Injuries	Number of Vehicles	Manner of Collision	Vehicle Travel Directions	Crash Time	Road Surface	Ambient Light	Weather Condition	Roadway	Near Intersection Roadway	Traffic Control Device Type	X	Y
2013																		
3414934	53	1	3/29/2013	Non-fatal injury	1	0	2	Rear-end	V1:8 / V2:8	4:30 PM	Dry	Daylight	Clear/Clear	GORHAM STREET / HIGHLAND STREET		Traffic control signal	215672.6876	931841.7498
3420023	54	1	4/10/2013	Not Reported	0	0	3	Rear-end	V1:S / V2:S / V3:S	7:30 AM	Dry	Daylight	Clear	GORHAM STREET / ELM STREET		Traffic control signal	215672.6876	931841.7498
3528580	55	1	7/10/2013	Non-fatal injury	1	0	2	Rear-end	V1:N / V2:N	3:35 PM	Dry	Daylight	Clear	GORHAM STREET		Traffic control signal	215673.2692	931863.7349
3605566	56	1	10/4/2013	Property damage only (none injured)	0	0	2	Rear-end	V1:S / V2:S	7:04 PM	Wet	Dark - lighted roadway	Cloudy	GORHAM STREET / HIGHLAND STREET		Traffic control signal	215672.6876	931841.7498
3715941	57	1	12/12/2013	Non-fatal injury	2	0	2	Angle	V1:8 / V2:8	12:21 PM	Dry	Daylight	Clear/Clear	GORHAM STREET / HIGHLAND STREET / ELM STREET		Traffic control signal	215672.6876	931841.7498
3426528	59	2	5/15/2013	Property damage only (none injured)	0	0	2	Rear-end	V1:S / V2:S	8:57 AM	Dry	Daylight	Clear/Clear	GORHAM STREET / SOUTH STREET		No controls	215669.828	931749.3123
3484035	60	2	6/18/2013	Property damage only (none injured)	0	0	2	Rear-end	V1:S / V2:S	12:00 AM	Dry	Daylight	Clear/Clear	GORHAM STREET / KEENE STREET		No controls	215668.0939	931688.1877
3524532	61	2	7/15/2013	Property damage only (none injured)	0	0	2	Rear-end	V1:8 / V2:8	7:00 PM	Dry	Daylight	Clear/Clear	GORHAM STREET		No controls	215668.1822	931691.4034
3722745	62	2	11/28/2013	Property damage only (none injured)	0	0	2	Angle	V1:N / V2:S	5:55 PM	Dry	Dark - lighted roadway	Clear	GORHAM STREET / AUBURN STREET		Stop signs	215671.3594	931799.0623
3384823	63	3	2/27/2013	Non-fatal injury	1	0	2	Angle	V1:S / V2:S	2:00 AM	Wet	Daylight	Rain/Rain	GORHAM STREET		No controls	215667.0625	931664.1806
3390547	64	3	3/8/2013	Property damage only (none injured)	0	0	2	Angle	V1:N / V2:S	12:04 PM	Ice	Daylight	Snow/Snow	GORHAM STREET		No controls	215667.0625	931664.1806
3530134	66	3	7/5/2013	Property damage only (none injured)	0	0	2	Sideswipe, same direction	V1:8 / V2:8	10:10 PM	Dry	Dark - lighted roadway	Clear/Clear	GORHAM STREET		Flashing traffic control signal	215668.1822	931691.4034
3560207	67	3	8/5/2013	Non-fatal injury	1	0	1	Single vehicle crash	V1:8	6:10 AM	Dry	Dawn	Clear	GORHAM STREET		No controls	215666.9396	931661.3212
3584361	68	3	8/26/2013	Property damage only (none injured)	0	0	2	Angle	V1:N / V2:W	12:00 AM	Dry	Dark - lighted roadway	Clear	LOWELL CONNECTOR Rte UNKNOW	GORHAM STREET	Traffic control signal	215666.9028	931660.4681
3600212	69	3	9/12/2013	Non-fatal injury	2	0	2	Angle	V1:N / V2:E	2:49 PM	Dry	Daylight	Cloudy	GORHAM STREET / LOWELL CONNECTOR		Traffic control signal	215666.903	931660.4685
3605170	70	3	9/30/2013	Property damage only (none injured)	0	0	3	Sideswipe, same direction	V1:E / V2:E / V3:E	4:05 PM	Dry	Daylight	Clear	GORHAM STREET	LOWELL CONNECTOR	No controls	215666.918	931660.8188

LOCATION KEY

1 = Gorham @ Elm Street
2 = Gorham St Segment Between
3 = Gorham @ Lowell Connector
4 = Gorham Street just south of Lowell Connector

Moving Massachusetts Forward. massDOT Highway

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Lowell, MA COUNT DATE : March, 2016

DISTRICT : 4 UNSIGNALIZED : [ ] SIGNALIZED : [X]

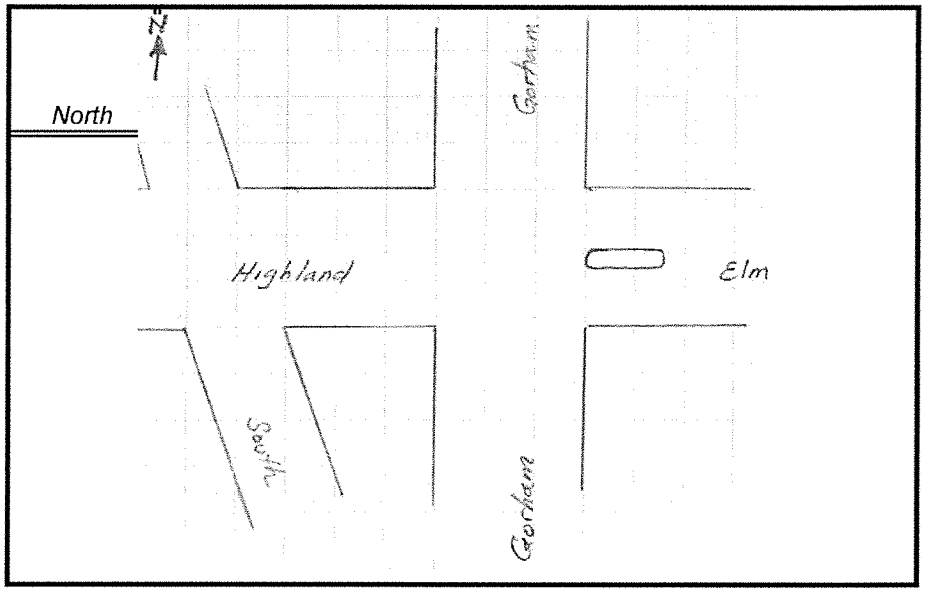
~ INTERSECTION DATA ~

MAJOR STREET : Gorham Street

MINOR STREET(S) : Elm Streeet

Highland Street

INTERSECTION DIAGRAM (Label Approaches)



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	NB	SB	EB	WB		
PEAK HOURLY VOLUMES (AM/PM) :	822	680	211	407		2,120

" K " FACTOR : 0.090

INTERSECTION ADT (V) = TOTAL DAILY APPROACH VOLUME : 23,556

TOTAL # OF CRASHES : 29

OF YEARS : 3

AVERAGE # OF CRASHES PER YEAR (A) : 9.67

CRASH RATE CALCULATION : 1.12

RATE = (A * 1,000,000) / (V * 365)

Comments :

Project Title & Date:

SEGMENT CRASH RATE WORKSHEET

CITY/TOWN : Lowell COUNT DATE : May-16

DISTRICT : 4

~ SEGMENT DATA ~

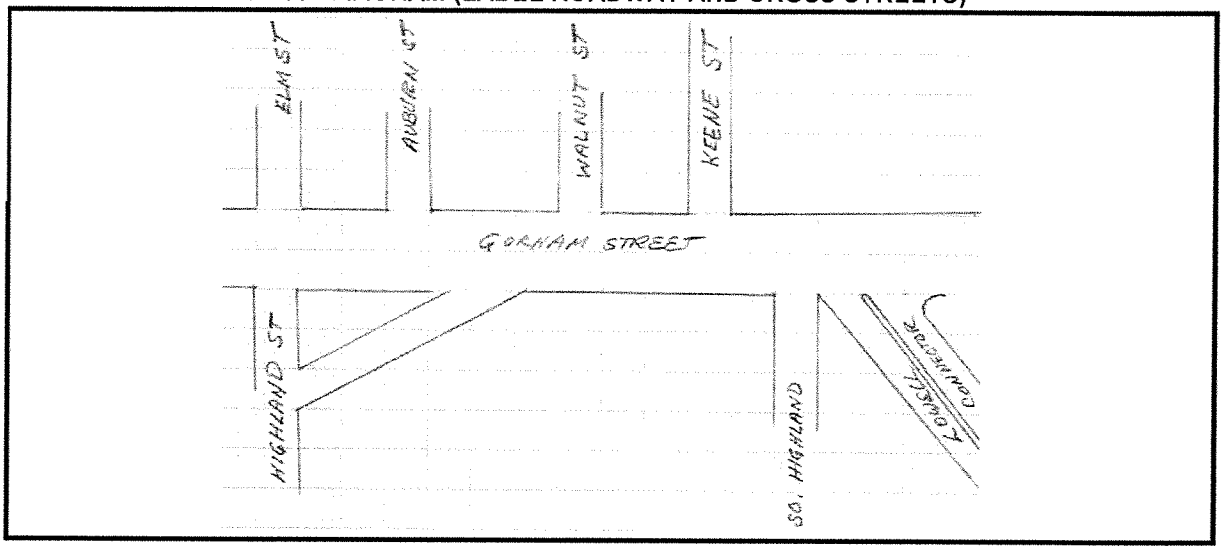
ROADWAY NAME: Gorham Street

START POINT: South Highland Street

END POINT: 150 feet south of Elm Street

FUNCTIONAL CLASSIFICATION OF ROADWAY: Urban Principal Arterial

ROADWAY DIAGRAM (LABEL ROADWAY AND CROSS STREETS)



AVERAGE DAILY TRAFFIC

SEGMENT LENGTH IN MILES (**L**): **0.1** (540 feet)

AVERAGE DAILY TRAFFIC VOLUME (**V**): 23,400

TOTAL # OF CRASHES:	18	# OF YEARS :	3	AVERAGE # OF CRASHES PER YEAR (**A**) :	**6.00**

CRASH RATE CALCULATION : **7.02**

RATE = $\frac{(A * 1{,}000{,}000)}{(L * V * 365)}$

Comments :

Project Title & Date:

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Lowell, MA COUNT DATE : March, 2016

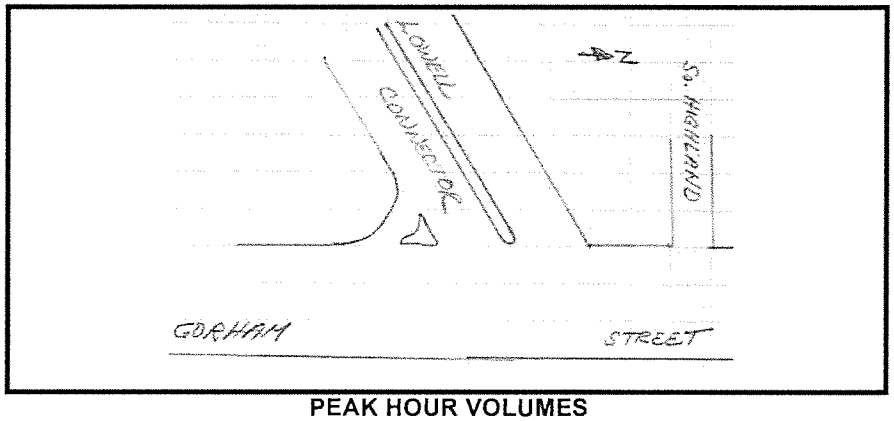
DISTRICT : 4 UNSIGNALIZED : [ ] SIGNALIZED : [X]

~ INTERSECTION DATA ~

MAJOR STREET : Gorham Street

MINOR STREET(S) : Lowell Connector

INTERSECTION DIAGRAM (Label Approaches)



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly
DIRECTION :	NB	SB	NEB			
PEAK HOURLY	130	852	909			1,891

" K " FACTOR : 0.100 INTERSECTION ADT (V) = TOTAL DAILY 18,910

TOTAL # OF CRASHES : 26 # OF YEARS : 3 AVERAGE # OF CRASHES PER YEAR (A) : 8.67

CRASH RATE CALCULATION : 1.26

$$RATE = \frac{(A * 1{,}000{,}000)}{(V * 365)}$$

Comments :

Project Title & Date:

SEGMENT CRASH RATE WORKSHEET

CITY/TOWN : Lowell COUNT DATE : Mar-16

DISTRICT : 4

~ SEGMENT DATA ~

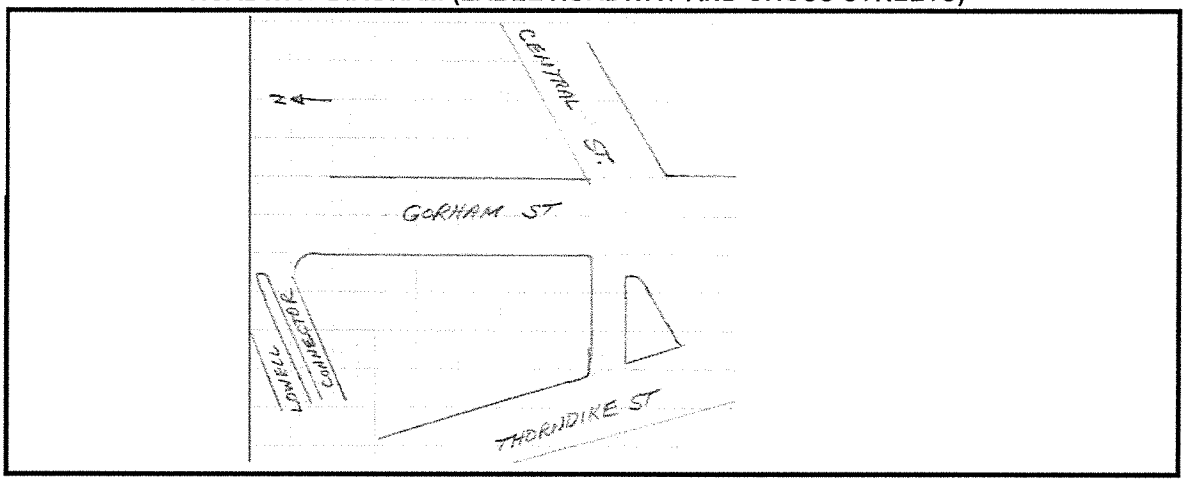
ROADWAY NAME: Gorham Street

START POINT: 100 feet north of Central Street

END POINT: 100 feet south of Lowell Connector

FUNCTIONAL CLASSIFICATION OF ROADWAY: Urban Principal Arterial

ROADWAY DIAGRAM (LABEL ROADWAY AND CROSS STREETS)



AVERAGE DAILY TRAFFIC

SEGMENT LENGTH IN MILES (L): 0.1 (500 ft)

AVERAGE DAILY TRAFFIC VOLUME (V): 4,930

TOTAL # OF CRASHES:	1	# OF YEARS :	3	AVERAGE # OF CRASHES PER YEAR (A) :	0.33

CRASH RATE CALCULATION : **1.85**

RATE = $\frac{(A * 1{,}000{,}000)}{(L * V * 365)}$

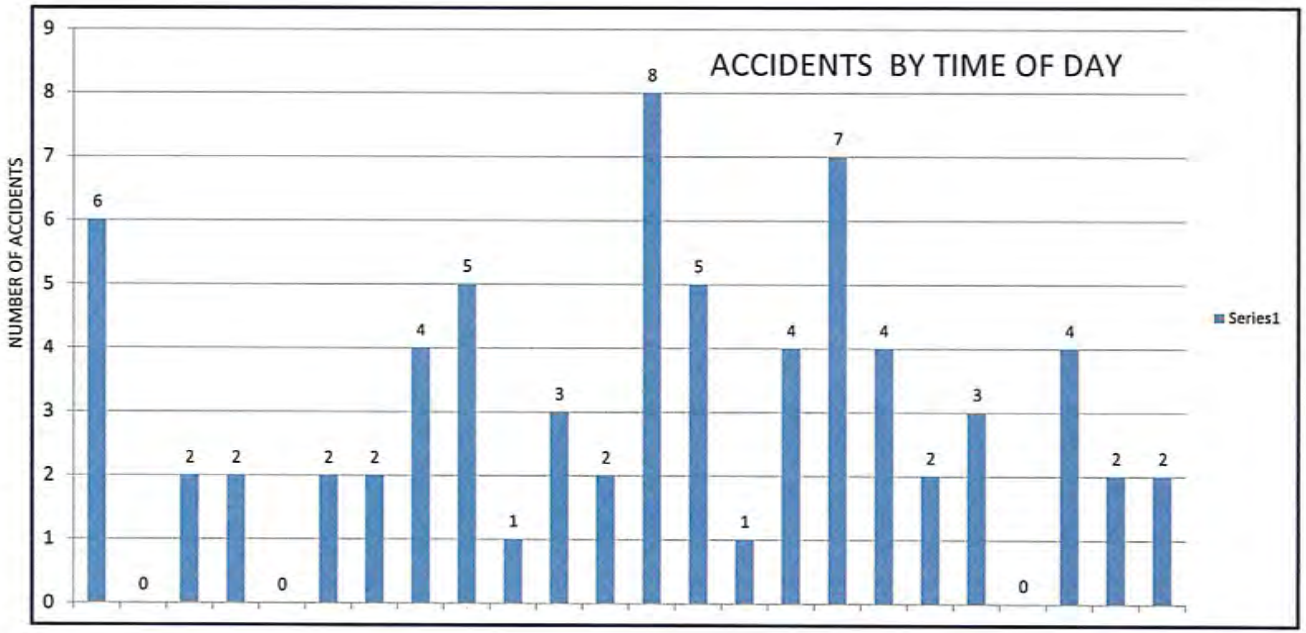
Comments :

Project Title & Date:

Gorham Street
from Lowell Connector to Elm/Highland Streets
Accident Data Breakdown

CRASHES BY HOUR

12 AM	6	8%
1 AM	0	0%
2 AM	2	3%
3 AM	2	3%
4 AM	0	0%
5 AM	2	3%
6 AM	2	3%
7 AM	4	6%
8 AM	5	7%
9 AM	1	1%
10 AM	3	4%
11 AM	2	3%
12 PM	8	11%
1 PM	5	7%
2 PM	1	1%
3 PM	4	6%
4 PM	7	10%
5 PM	4	6%
6 PM	2	3%
7 PM	3	4%
8 PM	0	0%
9 PM	4	6%
10 PM	2	3%
11 PM	2	3%
	71	

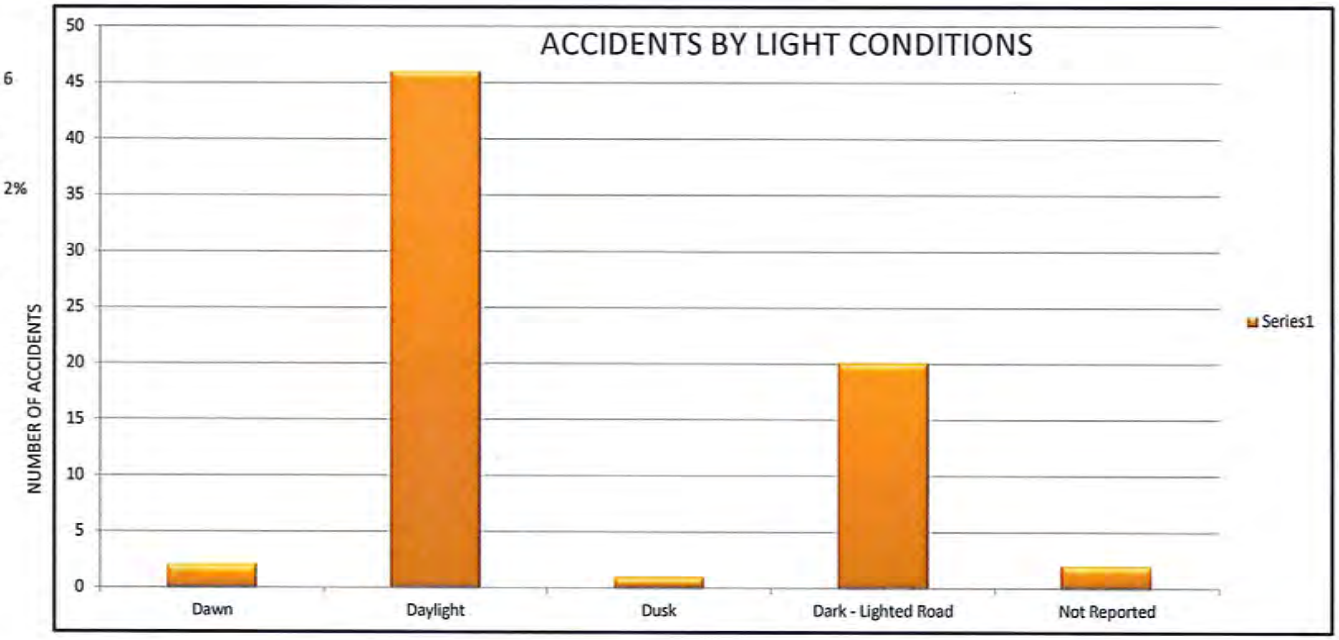


Gorham Street
from Lowell Connector to Elm/Highland Streets
Accident Data Breakdown

LIGHTING CONDITIONS		
Dawn	2	3%
Daylight	46	65%
Dusk	1	1%
Dark - Lighted Road	20	28%
Not Reported	2	3%
	71	

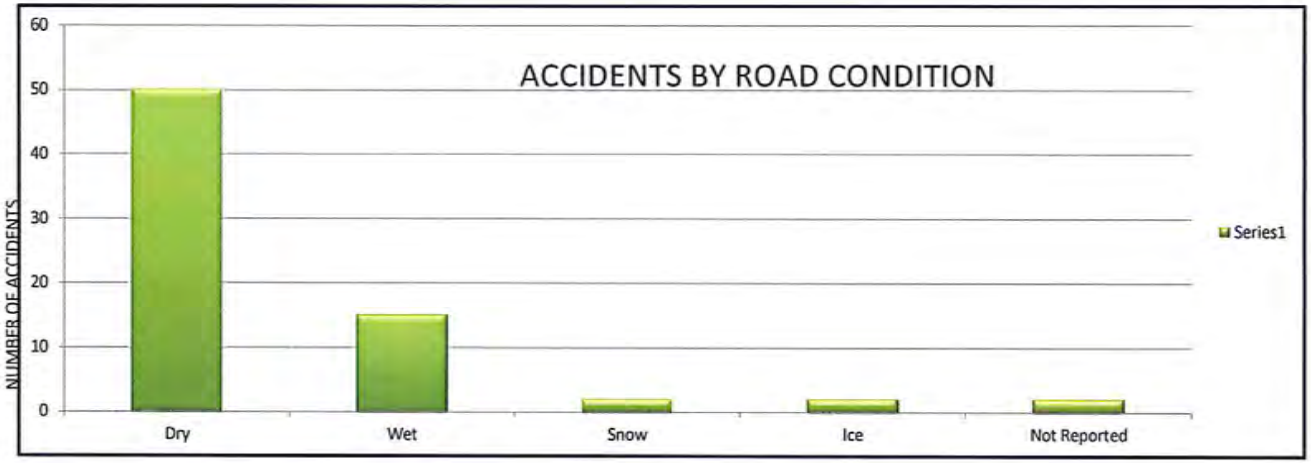
6

2%



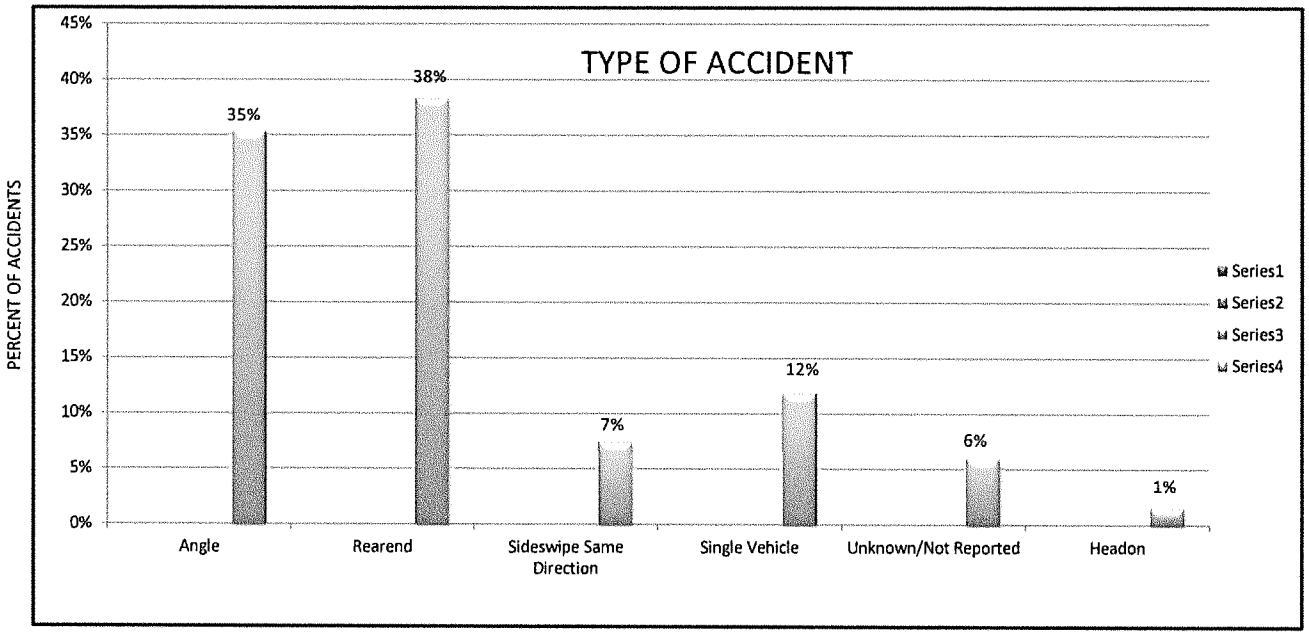
Gorham Street
from Lowell Connector to Elm/Highland Streets
Accident Data Breakdown

ROAD SURFACE		
Dry	50	70%
Wet	15	21%
Snow	2	3%
Ice	2	3%
Not Reported	2	3%
	71	



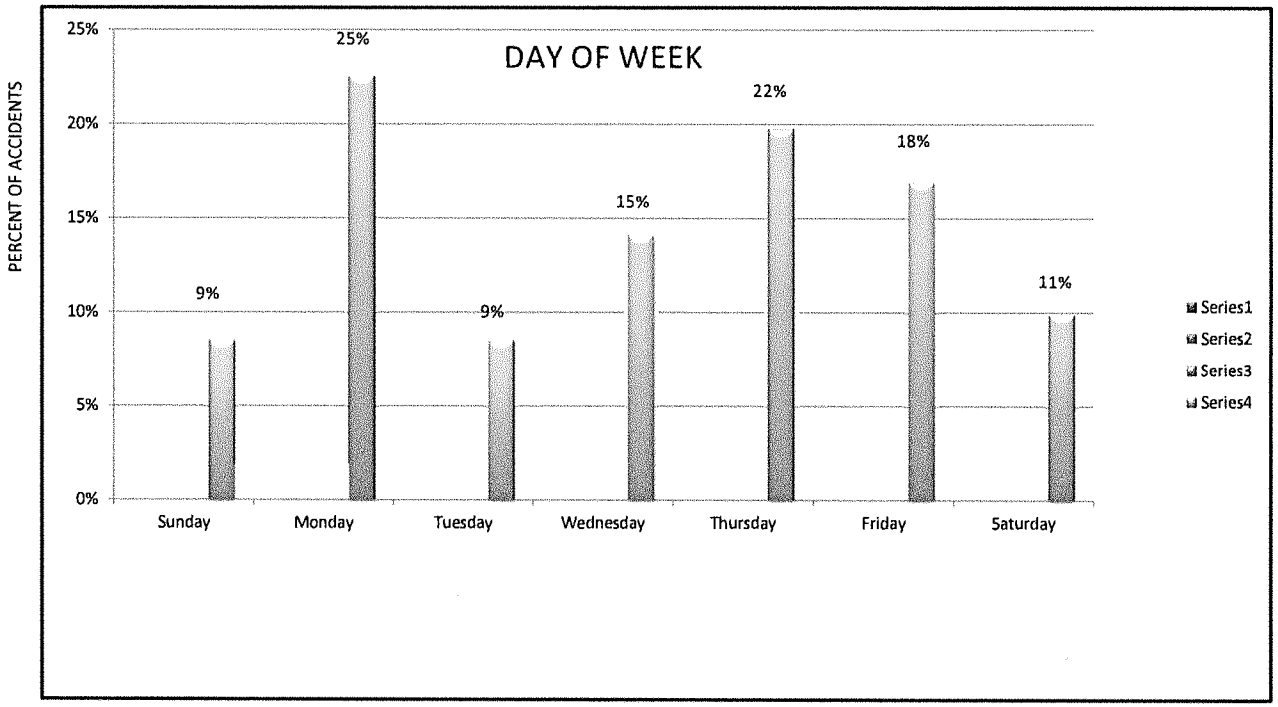
Gorham Street
from Lowell Connector to Elm/Highland Streets
Accident Data Breakdown

Manner		
Angle	35%	24
Rearend	38%	26
Sideswipe Same Directic	7%	5
Single Vehicle	12%	8
Unknown/Not Reported	6%	4
Headon	1%	1
		68



Gorham Street
from Lowell Connector to Elm/Highland Streets
Accident Data Breakdown

Day		
Sunday	8%	6
Monday	23%	16
Tuesday	8%	6
Wednesday	14%	10
Thursday	20%	14
Friday	17%	12
Saturday	10%	7
	100%	71



Appendix D. Selected Traffic Counts

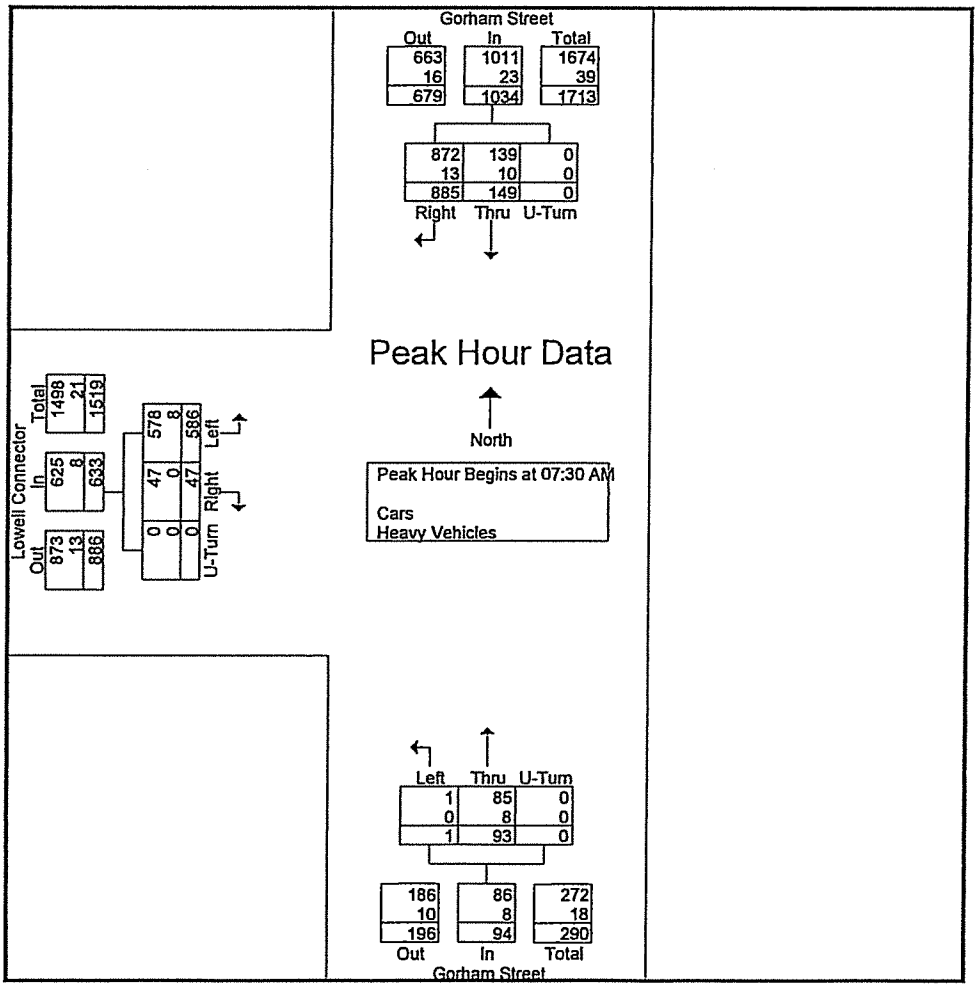
Page

PRECISION
D A T A
INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

N/S: Gorham Street
E/W: Lowell Connector
City, State: Lowell, MA
Client: CDR Maguire/ J. Coogan

File Name : 154858 B
Site Code : TBA
Start Date : 3/3/2016
Page No : 1

	Gorham Street From North				Gorham Street From South				Lowell Connector From West				
Start Time	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:30 AM													
07:30 AM	238	29	0	267	25	0	0	25	8	133	0	141	433
07:45 AM	241	44	0	285	17	0	0	17	7	146	0	153	455
08:00 AM	210	31	0	241	25	1	0	26	14	146	0	160	427
08:15 AM	196	45	0	241	26	0	0	26	18	161	0	179	446
Total Volume	885	149	0	1034	93	1	0	94	47	586	0	633	1761
% App. Total	85.6	14.4	0		98.9	1.1	0		7.4	92.6	0		
PHF	.918	.828	.000	.907	.894	.250	.000	.904	.653	.910	.000	.884	.968
Cars	872	139	0	1011	85	1	0	86	47	578	0	625	1722
% Cars	98.5	93.3	0	97.8	91.4	100	0	91.5	100	98.6	0	98.7	97.8
Heavy Vehicles	13	10	0	23	8	0	0	8	0	8	0	8	39
% Heavy Vehicles	1.5	6.7	0	2.2	8.6	0	0	8.5	0	1.4	0	1.3	2.2

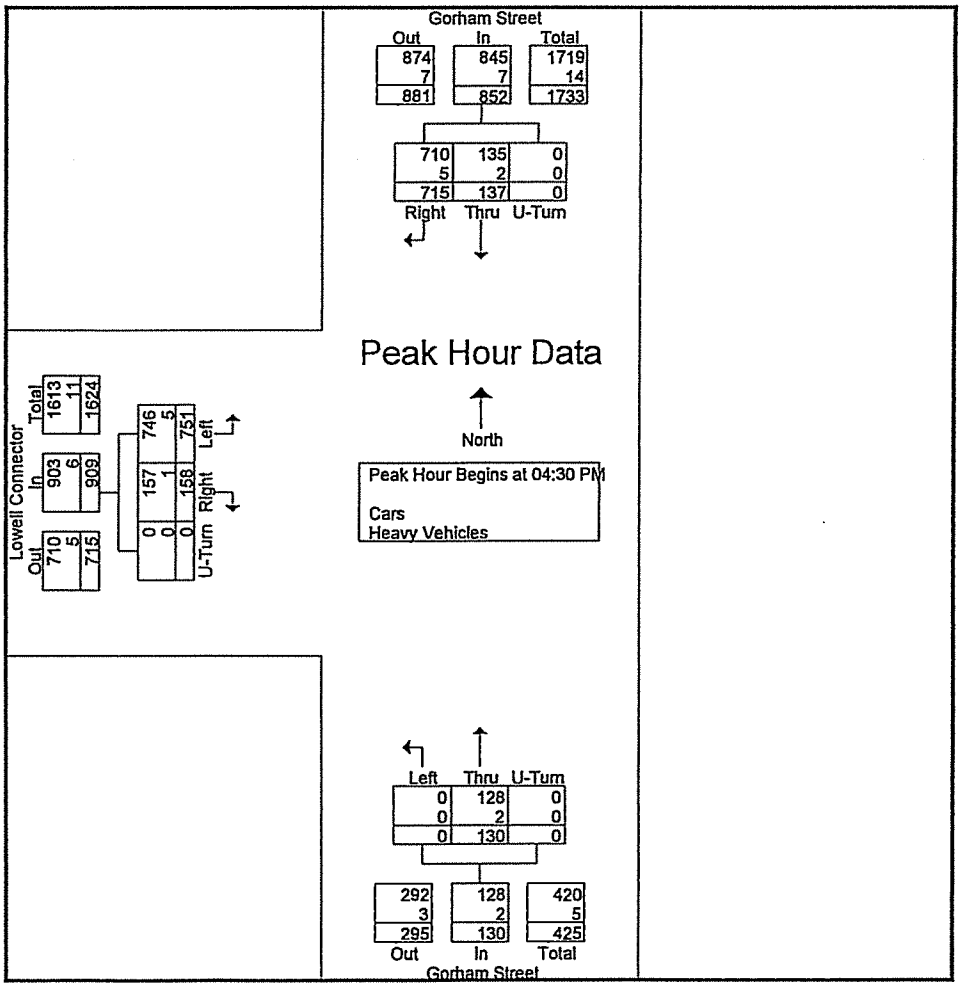


PRECISION
D A T A
INDUSTRIES, LLC
P.O.Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

N/S: Gorham Street
W: Lowell Connector
City, State: Lowell, MA
Client: CDR Maguire/ J. Coogan

File Name : 154858?
Site Code : TBA
Start Date : 3/3/2016
Page No : 1

	Gorham Street From North				Gorham Street From South				Lowell Connector From West				
Start Time	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:30 PM													
04:30 PM	172	39	0	211	40	0	0	40	36	194	0	230	481
04:45 PM	186	34	0	220	28	0	0	28	43	203	0	246	494
05:00 PM	182	32	0	214	29	0	0	29	37	171	0	208	451
05:15 PM	175	32	0	207	33	0	0	33	42	183	0	225	465
Total Volume	715	137	0	852	130	0	0	130	158	751	0	909	1891
% App. Total	83.9	16.1	0		100	0	0		17.4	82.6	0		
PHF	.961	.878	.000	.968	.813	.000	.000	.813	.919	.925	.000	.924	.957
Cars	710	135	0	845	128	0	0	128	157	746	0	903	1876
% Cars	99.3	98.5	0	99.2	98.5	0	0	98.5	99.4	99.3	0	99.3	99.2
Heavy Vehicles	5	2	0	7	2	0	0	2	1	5	0	6	15
% Heavy Vehicles	0.7	1.5	0	0.8	1.5	0	0	1.5	0.6	0.7	0	0.7	0.8



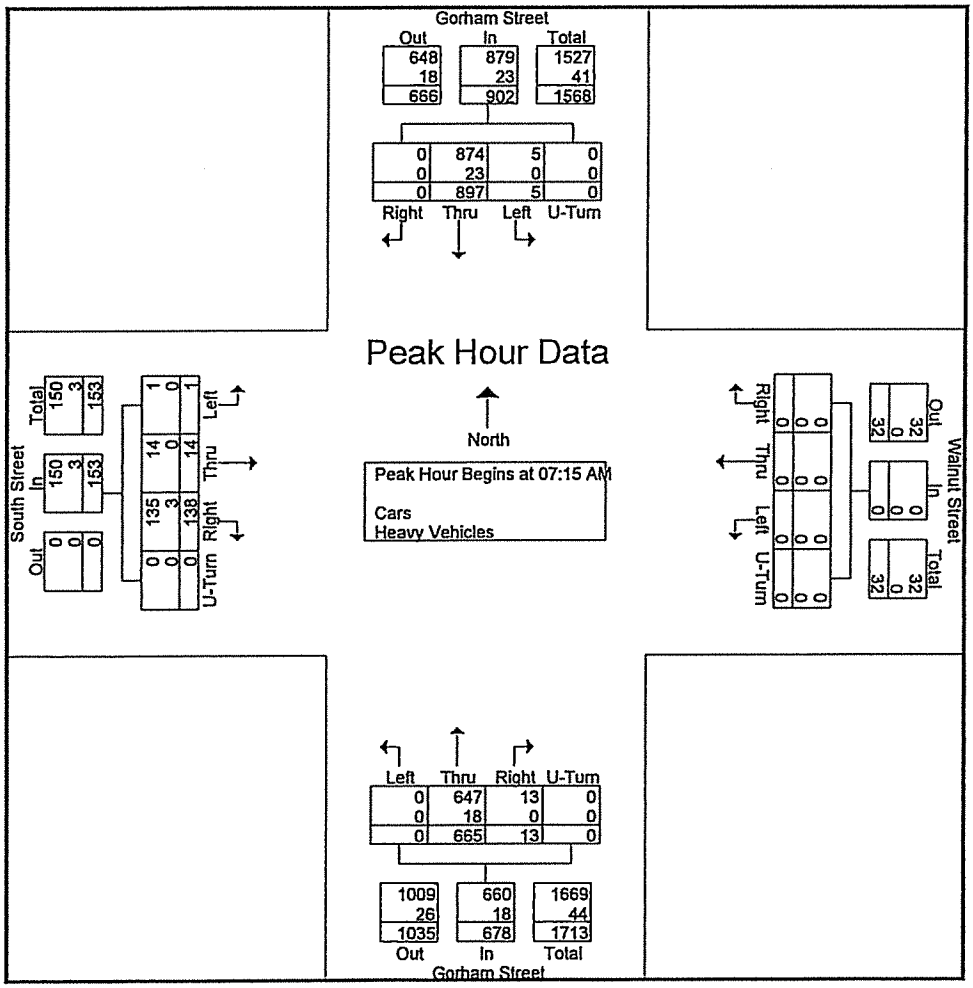
T-2

PRECISION
D A T A
INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

N/S: Gorham Street
E/W: Walnut Street/ South Street
City, State: Lowell, MA
Client: CDR Maguire/ J. Coogan

File Name : 154858 C
Site Code : TBA
Start Date : 3/3/2016
Page No : 1

	Gorham Street From North					Walnut Street From East					Gorham Street From South					South Street From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15 AM																					
07:15 AM	0	217	1	0	218	0	0	0	0	0	3	186	0	0	189	25	3	1	0	29	436
07:30 AM	0	235	1	0	236	0	0	0	0	0	1	158	0	0	159	35	5	0	0	40	435
07:45 AM	0	240	1	0	241	0	0	0	0	0	1	168	0	0	169	44	4	0	0	48	458
08:00 AM	0	205	2	0	207	0	0	0	0	0	8	153	0	0	161	34	2	0	0	36	404
Total Volume	0	897	5	0	902	0	0	0	0	0	13	665	0	0	678	138	14	1	0	153	1733
% App. Total	0	99.4	0.6	0		0	0	0	0		1.9	98.1	0	0		90.2	9.2	0.7	0		
PHF	.000	.934	.625	.000	.936	.000	.000	.000	.000	.000	.406	.894	.000	.000	.897	.784	.700	.250	.000	.797	.946
Cars	0	874	5	0	879	0	0	0	0	0	13	647	0	0	660	135	14	1	0	150	1689
% Cars	0	97.4	100	0	97.5	0	0	0	0	0	100	97.3	0	0	97.3	97.8	100	100	0	98.0	97.5
Heavy Vehicles	0	23	0	0	23	0	0	0	0	0	0	18	0	0	18	3	0	0	0	3	44
% Heavy Vehicles	0	2.6	0	0	2.5	0	0	0	0	0	0	2.7	0	0	2.7	2.2	0	0	0	2.0	2.5



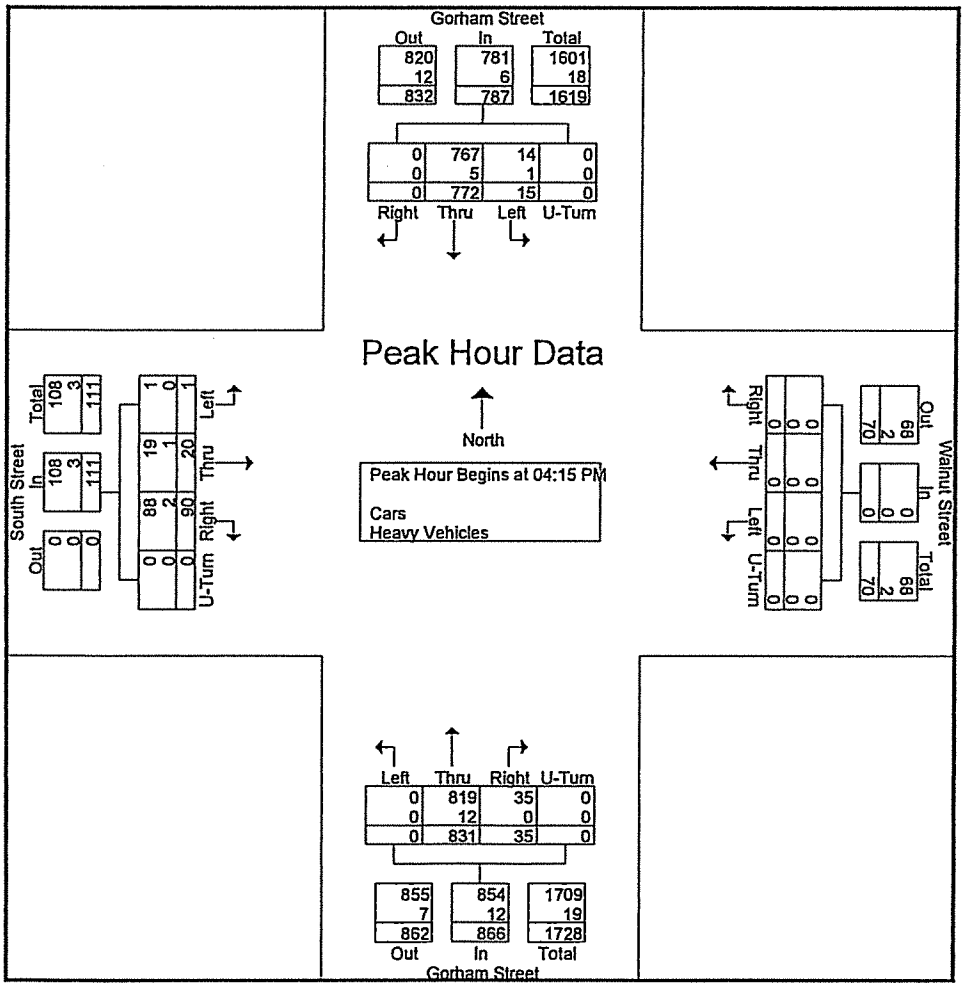
T-3

PRECISION
D A T A
INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

N/S: Gorham Street
E/W: Walnut Street/ South Street
City, State: Lowell, MA
Client: CDR Maguire/ J. Coogan

File Name : 154858 C
Site Code : TBA
Start Date : 3/3/2016
Page No : 1

	Gorham Street From North					Walnut Street From East					Gorham Street From South					South Street From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:15 PM																					
04:15 PM	0	188	5	0	193	0	0	0	0	0	8	204	0	0	212	24	7	0	0	31	436
04:30 PM	0	196	1	0	197	0	0	0	0	0	8	210	0	0	218	20	1	0	0	21	436
04:45 PM	0	198	3	0	201	0	0	0	0	0	5	222	0	0	227	18	4	0	0	22	450
05:00 PM	0	190	6	0	196	0	0	0	0	0	14	195	0	0	209	28	8	1	0	37	442
Total Volume	0	772	15	0	787	0	0	0	0	0	35	831	0	0	866	90	20	1	0	111	1764
% App. Total	0	98.1	1.9	0		0	0	0	0		4	96	0	0		81.1	18	0.9	0		
PHF	.000	.975	.625	.000	.979	.000	.000	.000	.000	.000	.625	.936	.000	.000	.954	.804	.625	.250	.000	.750	.980
Cars	0	767	14	0	781	0	0	0	0	0	35	819	0	0	854	88	19	1	0	108	1743
% Cars	0	99.4	93.3	0	99.2	0	0	0	0	0	100	98.6	0	0	98.6	97.8	95.0	100	0	97.3	98.8
Heavy Vehicles	0	5	1	0	6	0	0	0	0	0	0	12	0	0	12	2	1	0	0	3	21
% Heavy Vehicles	0	0.6	6.7	0	0.8	0	0	0	0	0	0	1.4	0	0	1.4	2.2	5.0	0	0	2.7	1.2



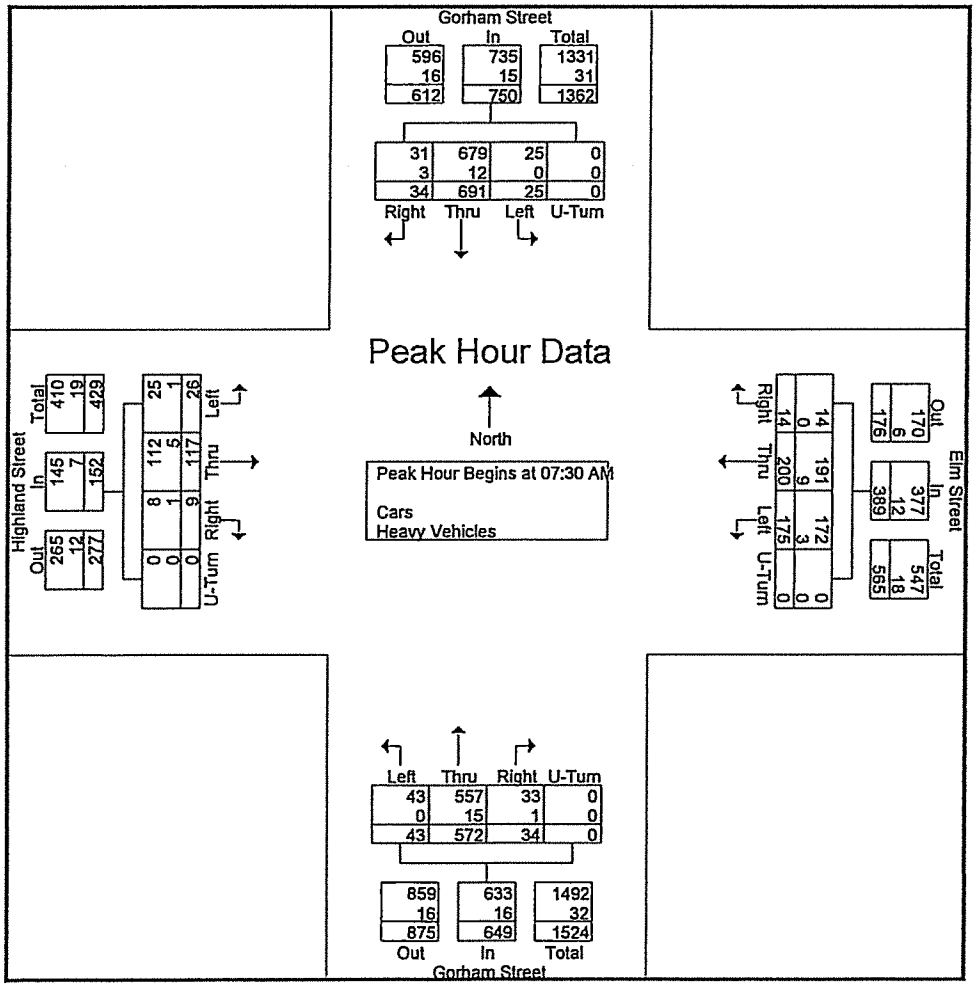
T-4

PRECISION
D A T A
INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

N/S: Gorham Street
E/W: Elm Street/ Highland Street
City, State: Lowell, MA
Client: CDR Maguire/ J. Coogan

File Name : 154858 D
Site Code : TBA
Start Date : 3/3/2016
Page No : 1

	Gorham Street From North					Elm Street From East					Gorham Street From South					Highland Street From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:30 AM																					
07:30 AM	12	168	6	0	186	2	52	48	0	102	2	139	11	0	152	1	23	5	0	29	469
07:45 AM	5	189	8	0	202	5	55	49	0	109	9	146	9	0	164	3	26	10	0	39	514
08:00 AM	10	164	6	0	180	5	44	39	0	88	6	136	11	0	153	2	32	8	0	42	463
08:15 AM	7	170	5	0	182	2	49	39	0	90	17	151	12	0	180	3	36	3	0	42	494
Total Volume	34	691	25	0	750	14	200	175	0	389	34	572	43	0	649	9	117	26	0	152	1940
% App. Total	4.5	92.1	3.3	0		3.6	51.4	45	0		5.2	88.1	6.6	0		5.9	77	17.1	0		
PHF	.708	.914	.781	.000	.928	.700	.909	.893	.000	.892	.500	.947	.896	.000	.901	.750	.813	.650	.000	.905	.944
Cars	31	679	25	0	735	14	191	172	0	377	33	557	43	0	633	8	112	25	0	145	1890
% Cars	91.2	98.3	100	0	98.0	100	95.5	98.3	0	96.9	97.1	97.4	100	0	97.5	88.9	95.7	96.2	0	95.4	97.4
Heavy Vehicles	3	12	0	0	15	0	9	3	0	12	1	15	0	0	16	1	5	1	0	7	50
% Heavy Vehicles	8.8	1.7	0	0	2.0	0	4.5	1.7	0	3.1	2.9	2.6	0	0	2.5	11.1	4.3	3.8	0	4.6	2.6



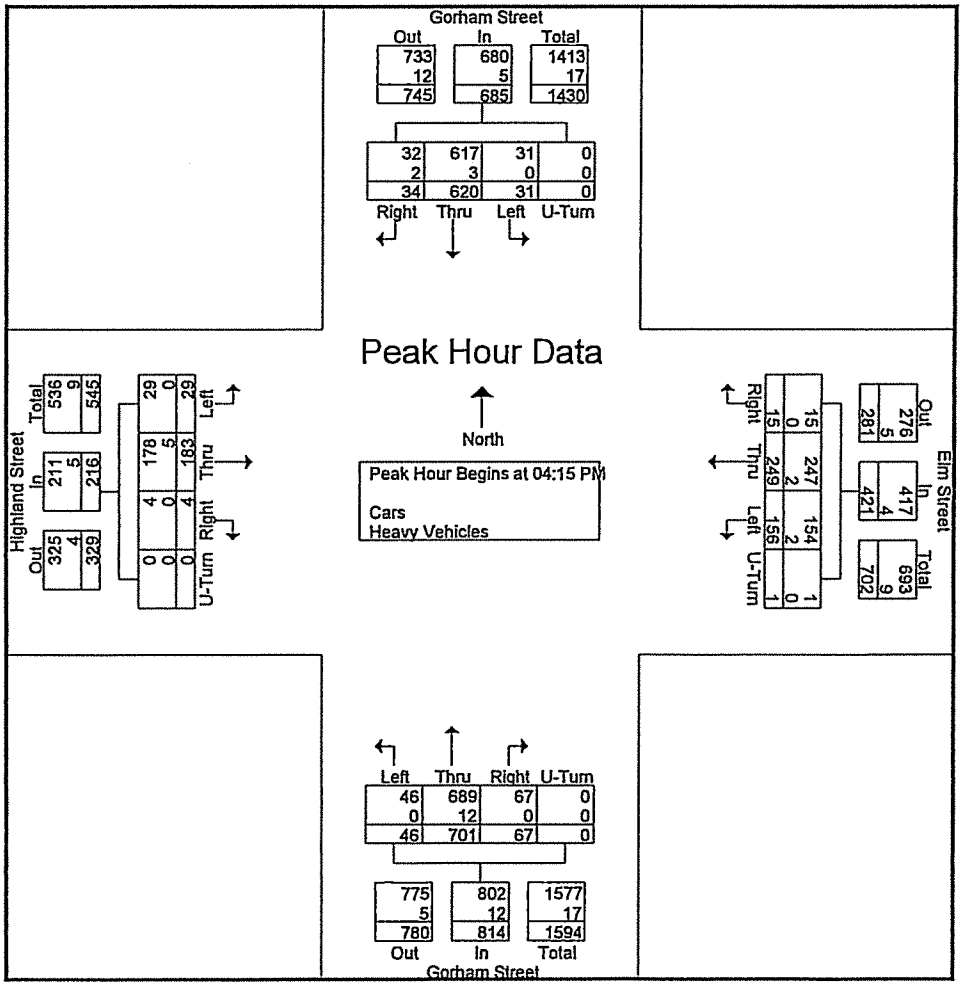
T-5

PRECISION DATA INDUSTRIES, LLC
P.O.Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

N/S: Gorham Street
E/W: Elm Street/ Highland Street
City, State: Lowell, MA
Client: CDR Maguire/ J. Coogan

File Name : 154858 E
Site Code : TBA
Start Date : 3/3/2016
Page No : 1

	Gorham Street From North					Elm Street From East					Gorham Street From South					Highland Street From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:15 PM																					
04:15 PM	7	154	6	0	167	7	53	33	0	93	17	167	8	0	192	3	47	5	0	55	507
04:30 PM	9	160	10	0	179	3	71	38	0	112	19	175	11	0	205	0	56	8	0	64	560
04:45 PM	8	158	7	0	173	2	68	40	0	110	18	185	18	0	221	1	37	5	0	43	547
05:00 PM	10	148	8	0	166	3	57	45	1	106	13	174	9	0	196	0	43	11	0	54	522
Total Volume	34	620	31	0	685	15	249	156	1	421	67	701	46	0	814	4	183	29	0	216	2136
% App. Total	5	90.5	4.5	0		3.6	59.1	37.1	0.2		8.2	86.1	5.7	0		1.9	84.7	13.4	0		
PHF	.850	.969	.775	.000	.957	.536	.877	.867	.250	.940	.882	.947	.639	.000	.921	.333	.817	.659	.000	.844	.954
Cars	32	617	31	0	680	15	247	154	1	417	67	689	46	0	802	4	178	29	0	211	2110
% Cars	94.1	99.5	100	0	99.3	100	99.2	98.7	100	99.0	100	98.3	100	0	98.5	100	97.3	100	0	97.7	98.8
Heavy Vehicles	2	3	0	0	5	0	2	2	0	4	0	12	0	0	12	0	5	0	0	5	26
% Heavy Vehicles	5.9	0.5	0	0	0.7	0	0.8	1.3	0	1.0	0	1.7	0	0	1.5	0	2.7	0	0	2.3	1.2



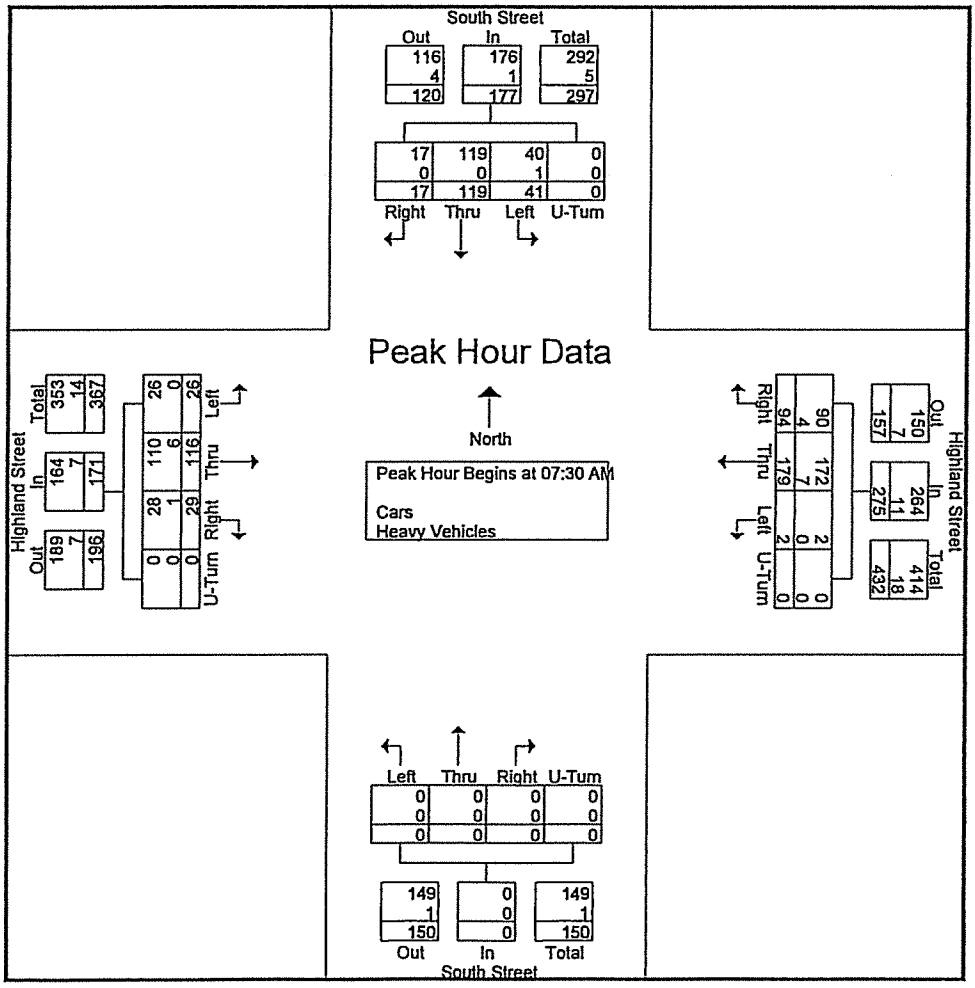
T-6

PRECISION
D A T A
INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

N/S: South Street
E/W: Highland Street
City, State: Lowell, MA
Client: CDR Maguire/ J. Coogan

File Name : 154858 E
Site Code : TBA
Start Date : 3/3/2016
Page No : 1

	South Street From North					Highland Street From East					South Street From South					Highland Street From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:30 AM																					
07:30 AM	4	36	6	0	46	29	46	0	0	75	0	0	0	0	0	9	24	2	0	35	156
07:45 AM	2	35	11	0	48	24	45	0	0	69	0	0	0	0	0	9	27	10	0	46	163
08:00 AM	4	29	13	0	46	26	40	0	0	66	0	0	0	0	0	8	34	9	0	51	163
08:15 AM	7	19	11	0	37	15	48	2	0	65	0	0	0	0	0	3	31	5	0	39	141
Total Volume	17	119	41	0	177	94	179	2	0	275	0	0	0	0	0	29	116	26	0	171	623
% App. Total	9.6	67.2	23.2	0		34.2	65.1	0.7	0		0	0	0	0		17	67.8	15.2	0		
PHF	.607	.826	.788	.000	.922	.810	.932	.250	.000	.917	.000	.000	.000	.000	.000	.806	.853	.650	.000	.838	.956
Cars	17	119	40	0	176	90	172	2	0	264	0	0	0	0	0	28	110	26	0	164	604
% Cars	100	100	97.6	0	99.4	95.7	96.1	100	0	96.0	0	0	0	0	0	96.6	94.8	100	0	95.9	97.0
Heavy Vehicles	0	0	1	0	1	4	7	0	0	11	0	0	0	0	0	1	6	0	0	7	19
% Heavy Vehicles	0	0	2.4	0	0.6	4.3	3.9	0	0	4.0	0	0	0	0	0	3.4	5.2	0	0	4.1	3.0



T-7

PRECISION
D A T A
INDUSTRIES, LLC
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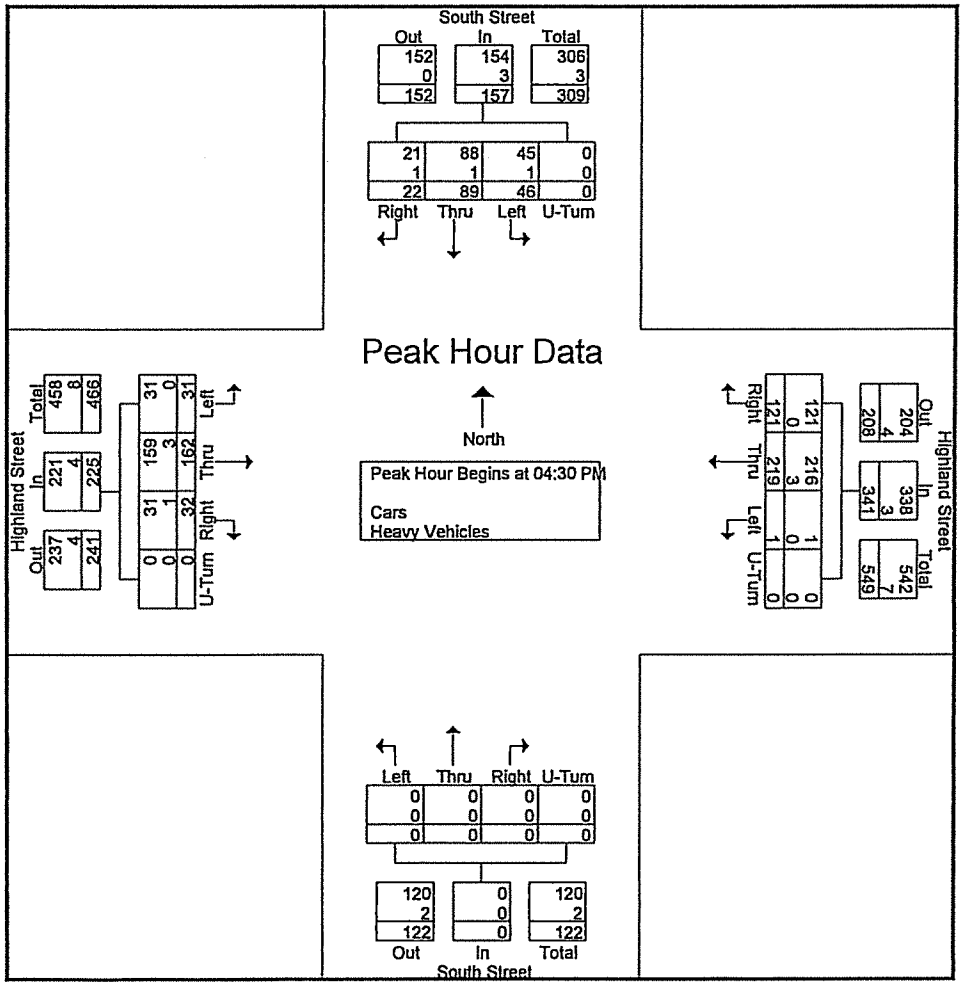
N/S: South Street
E/W: Highland Street
City, State: Lowell, MA
Client: CDR Maguire/ J. Coogan

File Name : 154858 F
Site Code : TBA
Start Date : 3/3/2016
Page No : 1

	South Street From North					Highland Street From East					South Street From South					Highland Street From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:30 PM																					
04:30 PM	7	12	14	0	33	24	68	0	0	92	0	0	0	0	0	7	46	8	0	61	186
04:45 PM	5	20	9	0	34	43	51	0	0	94	0	0	0	0	0	3	37	6	0	46	174
05:00 PM	6	25	11	0	42	25	51	0	0	76	0	0	0	0	0	14	44	10	0	68	186
05:15 PM	4	32	12	0	48	29	49	1	0	79	0	0	0	0	0	8	35	7	0	50	177
Total Volume	22	89	46	0	157	121	219	1	0	341	0	0	0	0	0	32	162	31	0	225	723
% App. Total	14	56.7	29.3	0		35.5	64.2	0.3	0		0	0	0	0		14.2	72	13.8	0		
PHF	.786	.695	.821	.000	.818	.703	.805	.250	.000	.907	.000	.000	.000	.000	.000	.571	.880	.775	.000	.827	.972
Cars	21	88	45	0	154	121	216	1	0	338	0	0	0	0	0	31	159	31	0	221	713
% Cars	95.5	98.9	97.8	0	98.1	100	98.6	100	0	99.1	0	0	0	0	0	96.9	98.1	100	0	98.2	98.6
Heavy Vehicles	1	1	1	0	3	0	3	0	0	3	0	0	0	0	0	1	3	0	0	4	10
% Heavy Vehicles	4.5	1.1	2.2	0	1.9	0	1.4	0	0	0.9	0	0	0	0	0	3.1	1.9	0	0	1.8	1.4



T-8

Gorham Street
south of Lowell Connector
City, State: Lowell, MA
Client: CDR Maguire / J. Coogan

PRECISION
D A T A
INDUSTRIES, LLC
P.O.Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

154858 A Volume
Site Code: TBA

Start		SB				NB				Combined				02-Mar-16
Time	A.M.		P.M.		A.M.		P.M.		A.M.		P.M.			Wed
12:00	7		40		6		24		13		64			
12:15	13		48		2		26		15		74			
12:30	5		43		7		28		12		71			
12:45	2	27	47	178	2	17	39	117	4	44	86	295		
01:00	5		36		3		25		8		61			
01:15	2		40		0		33		2		73			
01:30	1		42		1		27		2		69			
01:45	6	14	36	154	1	5	30	115	7	19	66	269		
02:00	4		40		2		34		6		74			
02:15	4		49		1		20		5		69			
02:30	0		68		2		28		2		96			
02:45	2	10	77	234	3	8	33	115	5	18	110	349		
03:00	2		48		3		40		5		88			
03:15	4		74		1		23		5		97			
03:30	5		55		4		30		9		85			
03:45	4	15	71	248	0	8	22	115	4	23	93	363		
04:00	1		56		2		34		3		90			
04:15	4		60		1		23		5		83			
04:30	4		72		2		30		6		102			
04:45	6	15	64	252	4	9	20	107	10	24	84	359		
05:00	8		67		7		31		15		98			
05:15	16		74		5		24		21		98			
05:30	22		72		3		30		25		102			
05:45	23	69	66	279	9	24	22	107	32	93	88	386		
06:00	26		52		7		32		33		84			
06:15	33		46		10		22		43		68			
06:30	35		50		13		24		48		74			
06:45	38	132	46	194	10	40	28	106	48	172	74	300		
07:00	32		35		19		23		51		58			
07:15	33		30		26		17		59		47			
07:30	48		37		29		19		77		56			
07:45	45	158	32	134	20	94	14	73	65	252	46	207		
08:00	47		27		25		13		72		40			
08:15	36		28		33		24		69		52			
08:30	43		33		21		12		64		45			
08:45	46	172	21	109	23	102	20	69	69	274	41	178		
09:00	35		38		34		14		69		52			
09:15	42		28		34		17		76		45			
09:30	43		25		35		15		78		40			
09:45	34	154	24	115	27	130	6	52	61	284	30	167		
10:00	32		23		29		4		61		27			
10:15	39		15		23		11		62		26			
10:30	40		16		27		8		67		24			
10:45	39	150	18	72	20	99	6	29	59	249	24	101		
11:00	42		14		24		11		66		25			
11:15	36		10		31		7		67		17			
11:30	39		8		23		3		62		11			
11:45	41	158	4	36	28	106	4	25	69	264	8	61		
Total	1074		2005		642		1030		1716		3035			
Percent	62.6%		66.1%		37.4%		33.9%							
Day Total		3079				1672				4751				
Peak	07:30	-	05:00	-	09:00	-	02:45	-	08:45	-	02:30	-	-	-
Vol.	176	-	279	-	130	-	126	-	292	-	391	-	-	-
P.H.F.	0.917		0.943		0.929		0.788		0.936		0.889			

T- 9

Gorham Street
south of Lowell Connector
City, State: Lowell, MA
Client: CDR Maguire / J. Coogan

PRECISION
D A T A
INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

154858 A Class
Site Code: TBA

SB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
03/02/1														
6	0	19	7	0	1	0	0	0	0	0	0	0	0	27
01:00	0	9	2	0	3	0	0	0	0	0	0	0	0	14
02:00	0	5	5	0	0	0	0	0	0	0	0	0	0	10
03:00	0	12	3	0	0	0	0	0	0	0	0	0	0	15
04:00	0	11	4	0	0	0	0	0	0	0	0	0	0	15
05:00	1	48	15	0	5	0	0	0	0	0	0	0	0	69
06:00	0	82	36	2	12	0	0	0	0	0	0	0	0	132
07:00	0	99	43	1	14	1	0	0	0	0	0	0	0	158
08:00	0	115	37	2	17	1	0	0	0	0	0	0	0	172
09:00	0	92	46	1	15	0	0	0	0	0	0	0	0	154
10:00	0	101	29	4	12	1	1	2	0	0	0	0	0	150
11:00	0	107	36	0	15	0	0	0	0	0	0	0	0	158
12 PM	0	122	37	2	16	0	0	1	0	0	0	0	0	178
13:00	2	113	24	0	12	2	0	0	1	0	0	0	0	154
14:00	1	158	53	1	21	0	0	0	0	0	0	0	0	234
15:00	0	170	58	0	20	0	0	0	0	0	0	0	0	248
16:00	0	189	48	1	13	0	0	1	0	0	0	0	0	252
17:00	2	206	52	0	19	0	0	0	0	0	0	0	0	279
18:00	0	153	29	0	12	0	0	0	0	0	0	0	0	194
19:00	0	96	33	0	5	0	0	0	0	0	0	0	0	134
20:00	0	84	23	0	2	0	0	0	0	0	0	0	0	109
21:00	0	88	21	0	6	0	0	0	0	0	0	0	0	115
22:00	1	50	16	0	5	0	0	0	0	0	0	0	0	72
23:00	0	28	6	0	2	0	0	0	0	0	0	0	0	36
Total	7	2157	663	14	227	5	1	4	1	0	0	0	0	3079
Percent	0.2%	70.1%	21.5%	0.5%	7.4%	0.2%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak	05:00	08:00	09:00	10:00	08:00	07:00	10:00	10:00						08:00
Vol.	1	115	46	4	17	1	1	2						172
PM Peak	13:00	17:00	15:00	12:00	14:00	13:00		12:00	13:00					17:00
Vol.	2	206	58	2	21	2		1	1					279

T=10

PRECISION
D A T A
INDUSTRIES, LLC
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Gorham Street
south of Lowell Connector
City, State: Lowell, MA
Client: CDR Maguire / J. Coogan

154858 A Class
Site Code: TBA

NB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
03/02/1														
6	0	11	5	0	1	0	0	0	0	0	0	0	0	17
01:00	0	4	1	0	0	0	0	0	0	0	0	0	0	5
02:00	0	6	2	0	0	0	0	0	0	0	0	0	0	8
03:00	0	6	2	0	0	0	0	0	0	0	0	0	0	8
04:00	0	6	2	0	1	0	0	0	0	0	0	0	0	9
05:00	0	18	4	1	1	0	0	0	0	0	0	0	0	24
06:00	0	33	6	0	1	0	0	0	0	0	0	0	0	40
07:00	0	71	13	1	7	2	0	0	0	0	0	0	0	94
08:00	0	74	20	0	8	0	0	0	0	0	0	0	0	102
09:00	0	92	32	0	5	1	0	0	0	0	0	0	0	130
10:00	0	66	18	1	13	0	1	0	0	0	0	0	0	99
11:00	0	75	24	0	7	0	0	0	0	0	0	0	0	106
12 PM	0	83	21	4	9	0	0	0	0	0	0	0	0	117
13:00	0	83	25	0	7	0	0	0	0	0	0	0	0	115
14:00	0	90	19	1	5	0	0	0	0	0	0	0	0	115
15:00	0	81	25	0	9	0	0	0	0	0	0	0	0	115
16:00	0	84	19	0	4	0	0	0	0	0	0	0	0	107
17:00	0	81	19	0	6	0	0	1	0	0	0	0	0	107
18:00	0	83	20	0	3	0	0	0	0	0	0	0	0	106
19:00	0	52	18	0	3	0	0	0	0	0	0	0	0	73
20:00	0	50	17	0	2	0	0	0	0	0	0	0	0	69
21:00	0	37	11	0	4	0	0	0	0	0	0	0	0	52
22:00	0	26	2	0	1	0	0	0	0	0	0	0	0	29
23:00	0	21	2	0	2	0	0	0	0	0	0	0	0	25
Total	0	1233	327	8	99	3	1	1	0	0	0	0	0	1672
Percent	0.0%	73.7%	19.6%	0.5%	5.9%	0.2%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak		09:00	09:00	05:00	10:00	07:00	10:00							09:00
Vol.		92	32	1	13	2	1							130
PM Peak		14:00	13:00	12:00	12:00			17:00						12:00
Vol.		90	25	4	9			1						117

T-11

Gorham Street
south of Lowell Connector
City, State: Lowell, MA
Client: CDR Maguire / J. Coogan

PRECISION
DATA
INDUSTRIES, LLC
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Email: datarequests@pdillc.com

154858 A Speed
Site Code: TBA

SB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
03/02/ 16	0	1	8	9	7	2	0	0	0	0	0	0	0	27	32	27
01:00	0	0	3	6	3	1	0	0	1	0	0	0	0	14	33	29
02:00	0	0	0	3	5	0	1	0	0	1	0	0	0	10	41	34
03:00	0	1	1	3	6	2	1	1	0	0	0	0	0	15	38	32
04:00	0	0	1	9	3	0	2	0	0	0	0	0	0	15	33	30
05:00	1	0	6	17	37	8	0	0	0	0	0	0	0	69	33	30
06:00	1	1	21	51	43	14	1	0	0	0	0	0	0	132	33	29
07:00	0	1	30	72	49	5	1	0	0	0	0	0	0	158	32	28
08:00	3	9	54	79	27	0	0	0	0	0	0	0	0	172	29	25
09:00	2	3	28	69	45	5	2	0	0	0	0	0	0	154	32	28
10:00	5	7	25	63	40	8	2	0	0	0	0	0	0	150	32	27
11:00	1	5	18	78	44	12	0	0	0	0	0	0	0	158	32	28
12 PM	3	3	30	81	54	7	0	0	0	0	0	0	0	178	32	28
13:00	1	12	15	54	62	8	2	0	0	0	0	0	0	154	32	28
14:00	8	13	64	89	53	7	0	0	0	0	0	0	0	234	31	26
15:00	14	17	54	112	39	12	0	0	0	0	0	0	0	248	30	25
16:00	1	2	38	120	70	20	1	0	0	0	0	0	0	252	32	28
17:00	10	21	72	121	45	9	1	0	0	0	0	0	0	279	30	25
18:00	2	7	40	83	57	5	0	0	0	0	0	0	0	194	31	27
19:00	0	0	17	59	49	5	3	1	0	0	0	0	0	134	32	29
20:00	1	1	11	52	38	6	0	0	0	0	0	0	0	109	32	29
21:00	1	6	20	46	35	5	1	0	1	0	0	0	0	115	32	28
22:00	1	1	6	35	21	6	1	1	0	0	0	0	0	72	33	29
23:00	0	0	7	13	15	1	0	0	0	0	0	0	0	36	32	28
Total	55	111	569	1324	847	148	19	3	2	1	0	0	0	3079		
%	1.8%	3.6%	18.5%	43.0%	27.5%	4.8%	0.6%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%			
AM Peak	10:00	08:00	08:00	08:00	07:00	06:00	04:00	03:00	01:00	02:00				08:00		
Vol.	5	9	54	79	49	14	2	1	1	1				172		
PM Peak	15:00	17:00	17:00	17:00	16:00	16:00	19:00	19:00	21:00					17:00		
Vol.	14	21	72	121	70	20	3	1	1					279		

Stats

15th Percentile :	21 MPH
50th Percentile :	27 MPH
85th Percentile :	32 MPH
95th Percentile :	34 MPH
Mean Speed(Average) :	27 MPH
10 MPH Pace Speed :	25-34 MPH
Number in Pace :	2171
Percent in Pace :	70.5%
Number of Vehicles > 30 MPH :	851
Percent of Vehicles > 30 MPH :	27.6%

T-12

Gorham Street
south of Lowell Connector
City, State: Lowell, MA
Client: CDR Maguire / J. Coogan

PRECISION
D A T A
INDUSTRIES, LLC
P.O.Box 301 Berlin, MA 01503
Office:508.481.3999 Fax:508.545.1234
Email:datarequests@pdillc.com

154858 A Speed
Site Code: TBA

NB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
03/02/ 16	0	0	4	9	4	0	0	0	0	0	0	0	0	17	30	27
01:00	0	0	1	4	0	0	0	0	0	0	0	0	0	5	28	26
02:00	0	0	1	3	3	1	0	0	0	0	0	0	0	8	33	29
03:00	0	0	1	4	3	0	0	0	0	0	0	0	0	8	32	28
04:00	0	0	2	6	1	0	0	0	0	0	0	0	0	9	28	26
05:00	0	2	3	12	4	3	0	0	0	0	0	0	0	24	33	28
06:00	2	0	6	19	13	0	0	0	0	0	0	0	0	40	31	27
07:00	1	6	25	47	14	1	0	0	0	0	0	0	0	94	29	26
08:00	1	10	44	33	12	1	1	0	0	0	0	0	0	102	28	25
09:00	1	9	40	54	23	3	0	0	0	0	0	0	0	130	30	26
10:00	2	13	34	36	13	1	0	0	0	0	0	0	0	99	28	24
11:00	0	6	26	51	17	6	0	0	0	0	0	0	0	106	31	27
12 PM	0	6	25	56	27	3	0	0	0	0	0	0	0	117	31	27
13:00	1	5	23	57	23	6	0	0	0	0	0	0	0	115	31	27
14:00	0	6	34	53	20	2	0	0	0	0	0	0	0	115	30	26
15:00	1	14	29	56	14	1	0	0	0	0	0	0	0	115	28	25
16:00	1	2	19	55	23	7	0	0	0	0	0	0	0	107	32	27
17:00	0	6	30	53	15	3	0	0	0	0	0	0	0	107	29	26
18:00	0	4	40	50	12	0	0	0	0	0	0	0	0	106	28	25
19:00	0	3	12	35	18	5	0	0	0	0	0	0	0	73	32	28
20:00	0	1	21	29	16	2	0	0	0	0	0	0	0	69	31	27
21:00	0	2	14	24	10	1	0	1	0	0	0	0	0	52	31	27
22:00	0	0	8	8	11	1	1	0	0	0	0	0	0	29	32	28
23:00	0	0	7	10	7	1	0	0	0	0	0	0	0	25	32	27
Total	10	95	449	764	303	48	2	1	0	0	0	0	0	1672		
%	0.6%	5.7%	26.9%	45.7%	18.1%	2.9%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%			
AM Peak	06:00	10:00	08:00	09:00	09:00	11:00	08:00							09:00		
Vol.	2	13	44	54	23	6	1							130		
PM Peak	13:00	15:00	18:00	13:00	12:00	16:00	22:00	21:00						12:00		
Vol.	1	14	40	57	27	7	1	1						117		

Stats

15th Percentile :	20 MPH
50th Percentile :	25 MPH
85th Percentile :	30 MPH
95th Percentile :	33 MPH
Mean Speed(Average) :	26 MPH
10 MPH Pace Speed :	20-29 MPH
Number in Pace :	1213
Percent in Pace :	72.5%
Number of Vehicles > 30 MPH :	293
Percent of Vehicles > 30 MPH :	17.5%

T 13

Gorham Street
north of Lowell Connector
City, State: Lowell, MA
Client: CDR Maguire/ J. Coogan

PRECISION
D A T A
INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office:508-875-0100 Fax:508-875-0118
Email:datarequests@pdillc.com

154858 ATR-B Volume
Site Code: TBA

Start	NB				SB				Combined				12-May-16
Time	A.M.		P.M.		A.M.		P.M.		A.M.		P.M.		Thu
12:00	35		127		14		171		49		298		
12:15	37		134		19		192		56		326		
12:30	18		139		16		145		34		284		
12:45	20	110	145	545	11	60	131	639	31	170	276	1184	
01:00	20		142		9		161		29		303		
01:15	15		141		9		165		24		306		
01:30	11		176		8		143		19		319		
01:45	12	58	185	644	12	38	170	639	24	96	355	1283	
02:00	15		179		14		166		29		345		
02:15	12		183		11		161		23		344		
02:30	6		166		10		201		16		367		
02:45	6	39	193	721	10	45	177	705	16	84	370	1426	
03:00	15		184		12		191		27		375		
03:15	11		179		11		180		22		359		
03:30	13		205		9		234		22		439		
03:45	5	44	199	767	11	43	194	799	16	87	393	1566	
04:00	2		196		14		187		16		383		
04:15	10		198		20		184		30		382		
04:30	8		214		30		228		38		442		
04:45	11	31	190	798	37	101	202	801	48	132	392	1599	
05:00	17		201		69		197		86		398		
05:15	17		230		112		204		129		434		
05:30	27		208		174		197		201		405		
05:45	33	94	211	850	190	545	156	754	223	639	367	1604	
06:00	29		211		216		169		245		380		
06:15	56		224		255		145		311		369		
06:30	72		202		251		130		323		332		
06:45	123	280	187	824	225	947	141	585	348	1227	328	1409	
07:00	117		201		229		142		346		343		
07:15	158		172		239		123		397		295		
07:30	182		152		261		124		443		276		
07:45	191	648	139	664	291	1020	98	487	482	1668	237	1151	
08:00	172		139		267		121		439		260		
08:15	174		152		226		98		400		250		
08:30	179		140		182		126		361		266		
08:45	178	703	122	553	172	847	115	460	350	1550	237	1013	
09:00	167		114		188		120		355		234		
09:15	216		118		170		105		386		223		
09:30	151		128		163		79		314		207		
09:45	154	688	103	463	129	650	68	372	283	1338	171	835	
10:00	111		100		120		64		231		164		
10:15	127		98		138		68		265		166		
10:30	147		107		139		63		286		170		
10:45	145	530	64	369	150	547	52	247	295	1077	116	616	
11:00	126		57		143		45		269		102		
11:15	123		82		149		37		272		119		
11:30	129		68		147		38		276		106		
11:45	147	525	45	252	150	589	29	149	297	1114	74	401	
Total	3750		7450		5432		6637		9182		14087		
Percent	40.8%		52.9%		59.2%		47.1%						
Day Total		11200				12069				23269			
Peak	08:30	-	05:15	-	07:15	-	04:30	-	07:30	-	04:30	-	-	-
Vol.	740	-	860	-	1058	-	831	-	1764	-	1666	-	-	-
P.H.F.	0.856		0.935		0.909		0.911		0.915		0.942			

T-14

Gorham Street
north of Lowell Connector
City, State: Lowell, MA
Client: CDR Maguire/ J. Coogan

PRECISION
D A T A
INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

154858 ATR-B Class
Site Code: TBA

NB

Start Time	Cars	Medium Heavy	Large Heavy											Total
05/11/1														
6	122	3	0	0	0	0	0	0	0	0	0	0	0	125
01:00	72	7	0	0	0	0	0	0	0	0	0	0	0	79
02:00	31	2	0	0	0	0	0	0	0	0	0	0	0	33
03:00	36	1	0	0	0	0	0	0	0	0	0	0	0	37
04:00	34	1	1	0	0	0	0	0	0	0	0	0	0	36
05:00	95	7	2	0	0	0	0	0	0	0	0	0	0	104
06:00	282	24	1	0	0	0	0	0	0	0	0	0	0	307
07:00	701	20	1	0	0	0	0	0	0	0	0	0	0	722
08:00	783	26	2	0	0	0	0	0	0	0	0	0	0	811
09:00	608	26	2	0	0	0	0	0	0	0	0	0	0	636
10:00	516	22	2	0	0	0	0	0	0	0	0	0	0	540
11:00	506	33	5	0	0	0	0	0	0	0	0	0	0	544
12 PM	599	20	1	0	0	0	0	0	0	0	0	0	0	620
13:00	610	18	2	0	0	0	0	0	0	0	0	0	0	630
14:00	708	24	2	0	0	0	0	0	0	0	0	0	0	734
15:00	714	12	0	0	0	0	0	0	0	0	0	0	0	726
16:00	813	8	2	0	0	0	0	0	0	0	0	0	0	823
17:00	823	9	2	0	0	0	0	0	0	0	0	0	0	834
18:00	804	10	0	0	0	0	0	0	0	0	0	0	0	814
19:00	625	7	0	0	0	0	0	0	0	0	0	0	0	632
20:00	501	5	0	0	0	0	0	0	0	0	0	0	0	506
21:00	480	6	0	0	0	0	0	0	0	0	0	0	0	486
22:00	291	6	1	0	0	0	0	0	0	0	0	0	0	298
23:00	243	3	1	0	0	0	0	0	0	0	0	0	0	247
Total	10997	300	27	0	0	0	0	0	0	0	0	0	0	11324
Percent	97.1%	2.6%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak	08:00	11:00	11:00											08:00
Vol.	783	33	5											811
PM Peak	17:00	14:00	13:00											17:00
Vol.	823	24	2											834

To 15

Gorham Street
north of Lowell Connector
City, State: Lowell, MA
Client: CDR Maguire/ J. Coogan

PRECISION
D A T A
INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

154858 ATR-B Class
Site Code: TBA

SB

Start Time	Cars	Medium Heavy	Large Heavy											Total
05/11/1														
6	38	1	0	0	0	0	0	0	0	0	0	0	0	39
01:00	41	7	0	0	0	0	0	0	0	0	0	0	0	48
02:00	40	5	0	0	0	0	0	0	0	0	0	0	0	45
03:00	28	0	0	0	0	0	0	0	0	0	0	0	0	28
04:00	112	4	0	0	0	0	0	0	0	0	0	0	0	116
05:00	551	2	1	0	0	0	0	0	0	0	0	0	0	554
06:00	924	19	1	0	0	0	0	0	0	0	0	0	0	944
07:00	1001	24	0	0	0	0	0	0	0	0	0	0	0	1025
08:00	796	20	2	0	0	0	0	0	0	0	0	0	0	818
09:00	694	19	0	0	0	0	0	0	0	0	0	0	0	713
10:00	585	12	0	0	0	0	0	0	0	0	0	0	0	597
11:00	616	18	0	0	0	0	0	0	0	0	0	0	0	634
12 PM	685	21	1	0	0	0	0	0	0	0	0	0	0	707
13:00	629	15	1	0	0	0	0	0	0	0	0	0	0	645
14:00	701	25	1	0	0	0	0	0	0	0	0	0	0	727
15:00	707	21	1	0	0	0	0	0	0	0	0	0	0	729
16:00	829	13	1	0	0	0	0	0	0	0	0	0	0	843
17:00	744	9	0	0	0	0	0	0	0	0	0	0	0	753
18:00	530	6	0	0	0	0	0	0	0	0	0	0	0	536
19:00	463	5	0	0	0	0	0	0	0	0	0	0	0	468
20:00	415	4	0	0	0	0	0	0	0	0	0	0	0	419
21:00	347	6	0	0	0	0	0	0	0	0	0	0	0	353
22:00	208	4	0	0	0	0	0	0	0	0	0	0	0	212
23:00	116	4	1	0	0	0	0	0	0	0	0	0	0	121
Total	11800	264	10	0	0	0	0	0	0	0	0	0	0	12074
Percent	97.7%	2.2%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak	07:00	07:00	08:00											07:00
Vol.	1001	24	2											1025
PM Peak	16:00	14:00	12:00											16:00
Vol.	829	25	1											843

T- 16

Gorham Street
north of Lowell Connector
City, State: Lowell, MA
Client: CDR Maguire / J. Coogan

PRECISION
D A T A
INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

154858 B Speed
Site Code: TBA

NB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
03/02/ 16	0	6	44	42	4	1	0	0	0	0	0	0	0	97	27	24
01:00	1	1	14	20	10	0	0	0	0	0	0	0	0	46	30	26
02:00	0	1	9	13	6	1	0	0	0	0	0	0	0	30	31	27
03:00	0	1	10	14	5	1	0	0	0	0	0	0	0	31	30	26
04:00	0	0	13	8	5	0	0	0	0	0	0	0	0	26	30	25
05:00	1	3	30	39	7	2	0	0	0	0	0	0	0	82	28	25
06:00	13	25	116	75	12	0	0	0	0	0	0	0	1	242	27	23
07:00	118	121	167	63	12	2	0	0	0	0	0	0	2	485	24	18
08:00	154	125	176	56	7	0	0	0	1	0	0	0	1	520	23	17
09:00	155	142	188	46	13	1	0	0	0	0	0	0	0	545	23	17
10:00	72	126	186	81	15	1	0	0	0	0	0	0	0	481	25	20
11:00	50	136	211	74	18	1	1	0	0	0	0	0	0	491	25	20
12 PM	37	131	219	110	27	3	0	0	0	0	0	0	0	527	26	21
13:00	92	147	211	91	14	1	0	0	0	0	0	0	0	556	25	19
14:00	126	185	187	45	4	1	0	0	0	0	0	0	1	549	23	17
15:00	263	119	155	16	2	1	1	0	1	0	0	0	0	558	21	14
16:00	208	117	213	41	10	0	0	0	1	0	0	0	1	591	23	16
17:00	268	137	153	9	1	0	0	0	0	0	0	0	0	568	21	14
18:00	189	222	168	51	12	2	2	0	0	0	0	0	1	647	23	17
19:00	59	122	200	86	20	3	1	0	0	0	0	0	0	491	26	20
20:00	30	77	197	100	17	3	0	0	0	0	0	0	0	424	26	22
21:00	20	61	185	100	23	1	1	0	0	0	0	0	0	391	27	22
22:00	2	20	110	81	21	2	1	0	0	0	0	0	0	237	28	24
23:00	4	17	109	82	15	3	0	0	0	0	0	0	0	230	27	24
Total	1862	2042	3271	1343	280	30	7	0	3	0	0	0	7	8845		
%	21.1%	23.1%	37.0%	15.2%	3.2%	0.3%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%			
AM Peak	09:00	09:00	11:00	10:00	11:00	05:00	11:00		08:00				07:00	09:00		
Vol.	155	142	211	81	18	2	1		1				2	545		
PM Peak	17:00	18:00	12:00	12:00	12:00	12:00	18:00		15:00				14:00	18:00		
Vol.	268	222	219	110	27	3	2		1				1	647		

Stats

15th Percentile :	9 MPH
50th Percentile :	19 MPH
85th Percentile :	25 MPH
95th Percentile :	28 MPH
Mean Speed(Average) :	19 MPH
10 MPH Pace Speed :	15-24 MPH
Number in Pace :	5313
Percent in Pace :	60.1%
Number of Vehicles > 25 MPH :	1401
Percent of Vehicles > 25 MPH :	15.8%

T- 17

Gorham Street
north of Lowell Connector
City, State: Lowell, MA
Client: CDR Maguire / J. Coogan

PRECISION
D A T A
INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

154858 B Speed
Site Code: TBA

SB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
03/02/ 16	2	2	20	27	7	1	0	0	0	0	0	0	0	59	28	25
01:00	1	2	7	9	2	2	0	0	0	0	0	0	0	23	30	25
02:00	0	1	3	24	3	0	0	1	0	1	0	0	0	33	29	28
03:00	0	2	5	20	9	2	1	0	0	0	0	0	0	39	32	28
04:00	0	3	28	69	11	2	0	0	0	0	0	0	0	113	28	26
05:00	4	14	116	308	60	0	0	0	0	0	0	0	0	502	28	26
06:00	14	41	293	445	55	2	0	0	0	0	0	0	0	850	28	25
07:00	38	106	398	230	15	1	0	0	0	0	0	0	1	789	26	22
08:00	49	112	426	146	10	0	0	0	0	0	0	0	1	744	25	21
09:00	24	82	259	163	14	0	2	0	0	0	0	0	0	544	26	22
10:00	19	61	253	175	13	1	0	0	0	0	0	0	1	523	27	23
11:00	37	96	262	177	14	1	0	0	0	0	0	0	0	587	26	22
12 PM	22	92	293	170	21	3	0	0	0	0	0	0	0	601	27	23
13:00	31	117	263	147	5	1	0	0	0	0	0	0	0	564	26	22
14:00	84	162	276	66	6	0	1	0	0	0	0	0	0	595	23	19
15:00	45	111	287	77	7	1	0	0	0	0	0	0	0	528	24	21
16:00	24	88	322	162	8	0	1	0	0	0	0	0	0	605	26	22
17:00	22	96	311	86	3	0	0	0	0	0	0	0	0	518	24	21
18:00	30	43	227	119	22	2	0	0	0	0	0	0	0	443	27	22
19:00	4	43	177	126	21	2	1	0	0	0	0	0	0	374	27	24
20:00	7	21	123	132	11	2	0	0	0	0	0	0	0	296	27	24
21:00	9	25	105	96	15	1	0	0	0	0	0	0	1	252	27	24
22:00	3	17	60	76	14	3	0	0	0	0	0	0	0	173	28	25
23:00	2	6	22	64	9	2	0	0	0	0	0	0	0	105	28	26
Total	471	1343	4536	3114	355	29	6	1	0	1	0	0	4	9860		
%	4.8%	13.6%	46.0%	31.6%	3.6%	0.3%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
AM Peak	08:00	08:00	08:00	06:00	05:00	01:00	09:00	02:00		02:00			07:00	06:00		
Vol.	49	112	426	445	60	2	2	1		1			1	850		
PM Peak	14:00	14:00	16:00	12:00	18:00	12:00	14:00						21:00	16:00		
Vol.	84	162	322	170	22	3	1						1	605		

Stats

15th Percentile :	17 MPH
50th Percentile :	22 MPH
85th Percentile :	27 MPH
95th Percentile :	28 MPH
Mean Speed(Average) :	23 MPH
10 MPH Pace Speed :	20-29 MPH
Number in Pace :	7650
Percent in Pace :	77.6%
Number of Vehicles > 25 MPH :	2887
Percent of Vehicles > 25 MPH :	29.3%

T- 18

Lowell Connector NB
west of Gorham Street
City, State: Lowell, MA
Client: CDR Maguire / J. Coogan

PRECISION
D A T A
INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

154858 CC Volume
Site Code: TBA

Start Time	A.M.	NB	P.M.													
																Wed 02-Mar-16
12:00	32		123													
12:15	35		159													
12:30	16		122													
12:45	10	93	133	537												
01:00	12		118													
01:15	16		149													
01:30	10		152													
01:45	7	45	146	565												
02:00	7		160													
02:15	9		174													
02:30	4		185													
02:45	6	26	214	733												
03:00	6		186													
03:15	3		191													
03:30	8		191													
03:45	7	24	167	735												
04:00	3		196													
04:15	7		199													
04:30	5		198													
04:45	7	22	210	803												
05:00	14		211													
05:15	15		202													
05:30	21		189													
05:45	26	76	176	778												
06:00	29		190													
06:15	50		174													
06:30	70		190													
06:45	109	258	177	731												
07:00	119		136													
07:15	140		146													
07:30	164		129													
07:45	162	585	116	527												
08:00	140		110													
08:15	152		105													
08:30	152		113													
08:45	166	610	102	430												
09:00	128		112													
09:15	132		94													
09:30	148		99													
09:45	121	529	77	382												
10:00	128		69													
10:15	115		58													
10:30	127		64													
10:45	112	482	50	241												
11:00	122		65													
11:15	110		58													
11:30	123		64													
11:45	123	478	36	223												
Total	3228		6685													
Percent			100.0 %		0.0%		0.0%									
Day Total		9913														
Peak	07:30	-	04:30	-	-	-	-	-	-	-	-	-	-	-	-	-
Vol.	618	-	821	-	-	-	-	-	-	-	-	-	-	-	-	-
P.H.F.	0.942		0.973													

T- 19

Lowell Connector NB
west of Gorham Street
City, State: Lowell, MA
Client: CDR Maguire / J. Coogan

PRECISION
D A T A
INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

154858 C Class
Site Code: TBA

NB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
03/02/1														
6	0	79	14	0	0	0	0	0	0	0	0	0	0	93
01:00	0	37	7	0	0	0	0	0	0	0	0	0	0	44
02:00	0	23	3	0	0	0	0	0	0	0	0	0	0	26
03:00	0	19	4	0	1	0	0	0	0	0	0	0	0	24
04:00	0	18	2	0	0	0	0	1	0	0	0	0	0	21
05:00	0	50	18	1	3	3	0	0	0	0	0	0	0	75
06:00	0	189	47	7	6	1	0	1	1	0	0	0	0	252
07:00	2	456	81	7	10	3	2	0	1	0	0	0	0	562
08:00	3	486	76	2	14	2	0	3	0	0	0	0	0	586
09:00	5	398	79	5	17	3	1	1	1	0	0	0	0	510
10:00	1	372	78	5	13	2	1	0	1	0	0	0	0	473
11:00	1	377	74	3	15	2	0	2	0	0	0	0	0	474
12 PM	5	410	83	6	19	2	1	1	0	0	0	0	0	527
13:00	4	438	89	4	15	2	0	1	0	0	0	0	0	553
14:00	5	549	119	4	15	5	0	2	0	0	0	0	0	699
15:00	8	528	122	2	8	5	2	1	0	0	0	0	1	677
16:00	7	628	112	1	11	3	0	4	0	0	0	0	0	766
17:00	9	534	86	2	9	4	0	6	0	1	0	0	0	651
18:00	5	602	88	2	7	2	1	0	0	0	0	0	0	707
19:00	2	450	61	0	6	1	1	0	0	0	0	0	0	521
20:00	3	363	47	1	5	2	0	1	0	0	0	0	0	422
21:00	0	322	43	2	7	2	0	0	0	0	0	0	0	376
22:00	0	214	22	0	2	0	1	0	0	0	0	0	0	239
23:00	1	193	27	0	0	1	0	0	0	0	0	0	0	222
Total	61	7735	1382	54	183	45	10	24	4	1	0	0	1	9500
Percent	0.6%	81.4%	14.5%	0.6%	1.9%	0.5%	0.1%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak	09:00	08:00	07:00	06:00	09:00	05:00	07:00	08:00	06:00					08:00
Vol.	5	486	81	7	17	3	2	3	1					586
PM Peak	17:00	16:00	15:00	12:00	12:00	14:00	15:00	17:00		17:00			15:00	16:00
Vol.	9	628	122	6	19	5	2	6		1			1	766

3' 2"

T- 20

Lowell Connector NB
west of Gorham Street
City, State: Lowell, MA
Client: CDR Maguire / J. Coogan

PRECISION
D A T A
INDUSTRIES, LLC
P.O.Box 301 Berlin, MA 01503
Office:508.481.3999 Fax:508.545.1234
Email:datarequests@pdillc.com

154858 C Speed
Site Code: TBA

NB

Start	1	15	20	25	30	35	40	45	50	55	60	65	70	Total	85th	Ave
Time	14	19	24	29	34	39	44	49	54	59	64	69	9999		% ile	Speed
03/02/																
16	0	3	5	25	35	20	4	1	0	0	0	0	0	93	36	31
01:00	0	1	1	10	18	10	3	1	0	0	0	0	0	44	37	32
02:00	0	0	0	6	13	5	2	0	0	0	0	0	0	26	37	33
03:00	0	0	2	6	8	5	3	0	0	0	0	0	0	24	38	32
04:00	0	0	0	8	8	2	3	0	0	0	0	0	0	21	38	32
05:00	0	0	2	15	34	20	4	0	0	0	0	0	0	75	37	33
06:00	0	7	22	59	91	48	22	2	1	0	0	0	0	252	37	32
07:00	13	31	105	165	155	69	18	6	0	0	0	0	0	562	34	28
08:00	49	51	104	171	129	64	16	2	0	0	0	0	0	586	33	26
09:00	29	47	96	146	104	75	9	4	0	0	0	0	0	510	34	27
10:00	4	15	54	143	133	86	32	3	3	0	0	0	0	473	37	30
11:00	2	26	62	131	149	78	20	5	1	0	0	0	0	474	36	30
12 PM	8	16	55	136	174	103	26	9	0	0	0	0	0	527	36	31
13:00	18	18	55	141	159	112	44	5	1	0	0	0	0	553	37	30
14:00	42	58	101	169	181	106	36	5	0	1	0	0	0	699	36	28
15:00	139	103	127	132	105	61	7	3	0	0	0	0	0	677	32	22
16:00	70	65	137	188	180	107	13	5	1	0	0	0	0	766	34	26
17:00	253	79	149	84	58	23	5	0	0	0	0	0	0	651	28	18
18:00	51	64	127	183	158	85	34	4	0	1	0	0	0	707	35	27
19:00	8	24	68	151	142	92	30	5	1	0	0	0	0	521	36	30
20:00	2	11	40	105	157	74	29	3	1	0	0	0	0	422	36	31
21:00	0	6	31	130	120	67	17	5	0	0	0	0	0	376	36	31
22:00	0	2	13	50	92	53	26	1	2	0	0	0	0	239	38	33
23:00	0	1	5	51	93	50	17	4	1	0	0	0	0	222	37	33
Total	688	628	1361	2405	2496	1415	420	73	12	2	0	0	0	9500		
%	7.2%	6.6%	14.3%	25.3%	26.3%	14.9%	4.4%	0.8%	0.1%	0.0%	0.0%	0.0%	0.0%			
AM Peak	08:00	08:00	07:00	08:00	07:00	10:00	10:00	07:00	10:00					08:00		
Vol.	49	51	105	171	155	86	32	6	3					586		
PM Peak	17:00	15:00	17:00	16:00	14:00	13:00	13:00	12:00	22:00	14:00				16:00		
Vol.	253	103	149	188	181	112	44	9	2	1				766		

Stats

15th Percentile :	19 MPH
50th Percentile :	28 MPH
85th Percentile :	35 MPH
95th Percentile :	39 MPH
Mean Speed(Average) :	28 MPH
10 MPH Pace Speed :	25-34 MPH
Number in Pace :	4901
Percent in Pace :	51.6%
Number of Vehicles > 35 MPH :	1639
Percent of Vehicles > 35 MPH :	17.3%

T- 21

Lowell Connector SB
west of Gorham Street
City, State: Lowell, MA
Client: CDR Maguire / J. Coogan

PRECISION
D A T A
INDUSTRIES, LLC
P.O.Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

154858 D Volume
Site Code: TBA

Start Time	A.M.	SB	P.M.												
															Wed 02-Mar-16
12:00	14		126												
12:15	9		137												
12:30	10		158												
12:45	11	44	112	533											
01:00	4		151												
01:15	6		112												
01:30	3		115												
01:45	4	17	139	517											
02:00	8		146												
02:15	2		155												
02:30	5		171												
02:45	7	22	148	620											
03:00	10		163												
03:15	5		150												
03:30	4		160												
03:45	8	27	165	638											
04:00	13		147												
04:15	22		169												
04:30	32		186												
04:45	38	105	172	674											
05:00	50		189												
05:15	101		196												
05:30	127		153												
05:45	166	444	146	684											
06:00	168		137												
06:15	203		113												
06:30	203		97												
06:45	205	779	87	434											
07:00	196		106												
07:15	203		70												
07:30	229		83												
07:45	209	837	70	329											
08:00	218		73												
08:15	199		60												
08:30	177		66												
08:45	162	756	56	255											
09:00	142		55												
09:15	138		52												
09:30	138		49												
09:45	106	524	34	190											
10:00	110		29												
10:15	111		28												
10:30	126		43												
10:45	123	470	32	132											
11:00	143		29												
11:15	112		25												
11:30	121		22												
11:45	129	505	17	93											
Total	4530		5099												
Percent			100.0 %		0.0%		0.0%								
Day Total		9629													
Peak	07:15	-	04:30	-	-	-	-	-	-	-	-	-	-	-	-
Vol.	859	-	743	-	-	-	-	-	-	-	-	-	-	-	-
P.H.F.	0.938		0.948												

T-22

Lowell Connector SB
west of Gorham Street
City, State: Lowell, MA
Client: CDR Maguire / J. Coogan

PRECISION
D A T A
INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

154858 D Class
Site Code: TBA

SB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
03/02/1														
6	0	37	5	0	2	0	0	0	0	0	0	0	0	44
01:00	0	14	3	0	0	0	0	0	0	0	0	0	0	17
02:00	0	15	7	0	0	0	0	0	0	0	0	0	0	22
03:00	0	24	3	0	0	0	0	0	0	0	0	0	0	27
04:00	0	84	18	0	3	0	0	0	0	0	0	0	0	105
05:00	1	353	78	1	10	1	0	0	0	0	0	0	0	444
06:00	0	653	114	1	9	0	0	1	1	0	0	0	0	779
07:00	1	726	96	1	9	1	0	3	0	0	0	0	0	837
08:00	5	660	74	3	13	1	0	0	0	0	0	0	0	756
09:00	0	444	64	1	14	1	0	0	0	0	0	0	0	524
10:00	1	389	64	2	13	0	1	0	0	0	0	0	0	470
11:00	1	405	88	0	10	1	0	0	0	0	0	0	0	505
12 PM	0	458	65	2	7	0	0	1	0	0	0	0	0	533
13:00	0	442	61	1	13	0	0	0	0	0	0	0	0	517
14:00	1	523	75	3	15	1	1	1	0	0	0	0	0	620
15:00	1	543	82	0	11	1	0	0	0	0	0	0	0	638
16:00	0	592	70	1	11	0	0	0	0	0	0	0	0	674
17:00	0	611	64	0	9	0	0	0	0	0	0	0	0	684
18:00	4	381	40	1	5	1	0	2	0	0	0	0	0	434
19:00	0	305	21	0	2	1	0	0	0	0	0	0	0	329
20:00	0	230	24	0	0	0	0	1	0	0	0	0	0	255
21:00	0	168	20	1	1	0	0	0	0	0	0	0	0	190
22:00	0	122	10	0	0	0	0	0	0	0	0	0	0	132
23:00	0	76	15	0	1	0	0	0	1	0	0	0	0	93
Total	15	8255	1161	18	158	9	2	9	2	0	0	0	0	9629
Percent	0.2%	85.7%	12.1%	0.2%	1.6%	0.1%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak	08:00	07:00	06:00	08:00	09:00	05:00	10:00	07:00	06:00					07:00
Vol.	5	726	114	3	14	1	1	3	1					837
PM Peak	18:00	17:00	15:00	14:00	14:00	14:00	14:00	18:00	23:00					17:00
Vol.	4	611	82	3	15	1	1	2	1					684

To 23

Lowell Connector SB
west of Gorham Street
City, State: Lowell, MA
Client: CDR Maguire / J. Coogan

PRECISION
D A T A
INDUSTRIES, LLC
P.O.Box 301 Berlin, MA 01503
Office:508.481.3999 Fax:508.545.1234
Email:datarequests@pdillc.com

154858 D Speed
Site Code: TBA

SB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
03/02/ 16	0	0	0	1	8	26	6	3	0	0	0	0	0	44	40	37
01:00	0	0	0	0	5	7	5	0	0	0	0	0	0	17	41	37
02:00	0	0	0	0	3	13	6	0	0	0	0	0	0	22	41	38
03:00	0	0	0	0	4	16	6	1	0	0	0	0	0	27	41	38
04:00	0	0	0	7	17	59	17	4	1	0	0	0	0	105	40	37
05:00	0	0	0	7	89	232	100	15	1	0	0	0	0	444	41	37
06:00	0	0	0	23	177	382	167	29	0	1	0	0	0	779	41	37
07:00	0	0	2	17	155	444	178	36	4	1	0	0	0	837	41	37
08:00	0	0	3	19	142	405	160	21	5	1	0	0	0	756	41	37
09:00	0	0	0	9	113	239	143	19	1	0	0	0	0	524	41	38
10:00	0	0	0	12	82	230	122	21	2	1	0	0	0	470	42	38
11:00	0	0	2	5	107	252	117	18	3	1	0	0	0	505	41	37
12 PM	0	0	0	22	125	243	118	22	2	1	0	0	0	533	41	37
13:00	0	0	1	12	105	263	113	15	7	1	0	0	0	517	41	37
14:00	0	0	1	17	142	305	129	25	1	0	0	0	0	620	41	37
15:00	0	0	0	10	132	326	142	24	3	1	0	0	0	638	41	37
16:00	0	0	0	11	148	384	115	14	2	0	0	0	0	674	40	37
17:00	0	0	0	12	117	345	178	29	1	2	0	0	0	684	42	38
18:00	0	1	1	17	116	196	86	14	3	0	0	0	0	434	41	37
19:00	0	0	1	7	80	155	66	17	2	1	0	0	0	329	41	37
20:00	0	0	0	7	64	127	47	10	0	0	0	0	0	255	40	37
21:00	0	1	0	9	44	87	34	13	2	0	0	0	0	190	42	37
22:00	0	0	2	5	27	60	31	5	2	0	0	0	0	132	41	37
23:00	0	0	0	3	17	40	29	4	0	0	0	0	0	93	42	38
Total	0	2	13	232	2019	4836	2115	359	42	11	0	0	0	9629		
%	0.0%	0.0%	0.1%	2.4%	21.0%	50.2%	22.0%	3.7%	0.4%	0.1%	0.0%	0.0%	0.0%			
AM Peak			08:00	06:00	06:00	07:00	07:00	07:00	08:00	06:00				07:00		
Vol.			3	23	177	444	178	36	5	1				837		
PM Peak		18:00	22:00	12:00	16:00	16:00	17:00	17:00	13:00	17:00				17:00		
Vol.		1	2	22	148	384	178	29	7	2				684		

Stats

15th Percentile :	31 MPH
50th Percentile :	36 MPH
85th Percentile :	41 MPH
95th Percentile :	43 MPH
Mean Speed(Average) :	37 MPH
10 MPH Pace Speed :	35-44 MPH
Number in Pace :	6951
Percent in Pace :	72.2%
Number of Vehicles > 40 MPH :	2104
Percent of Vehicles > 40 MPH :	21.9%

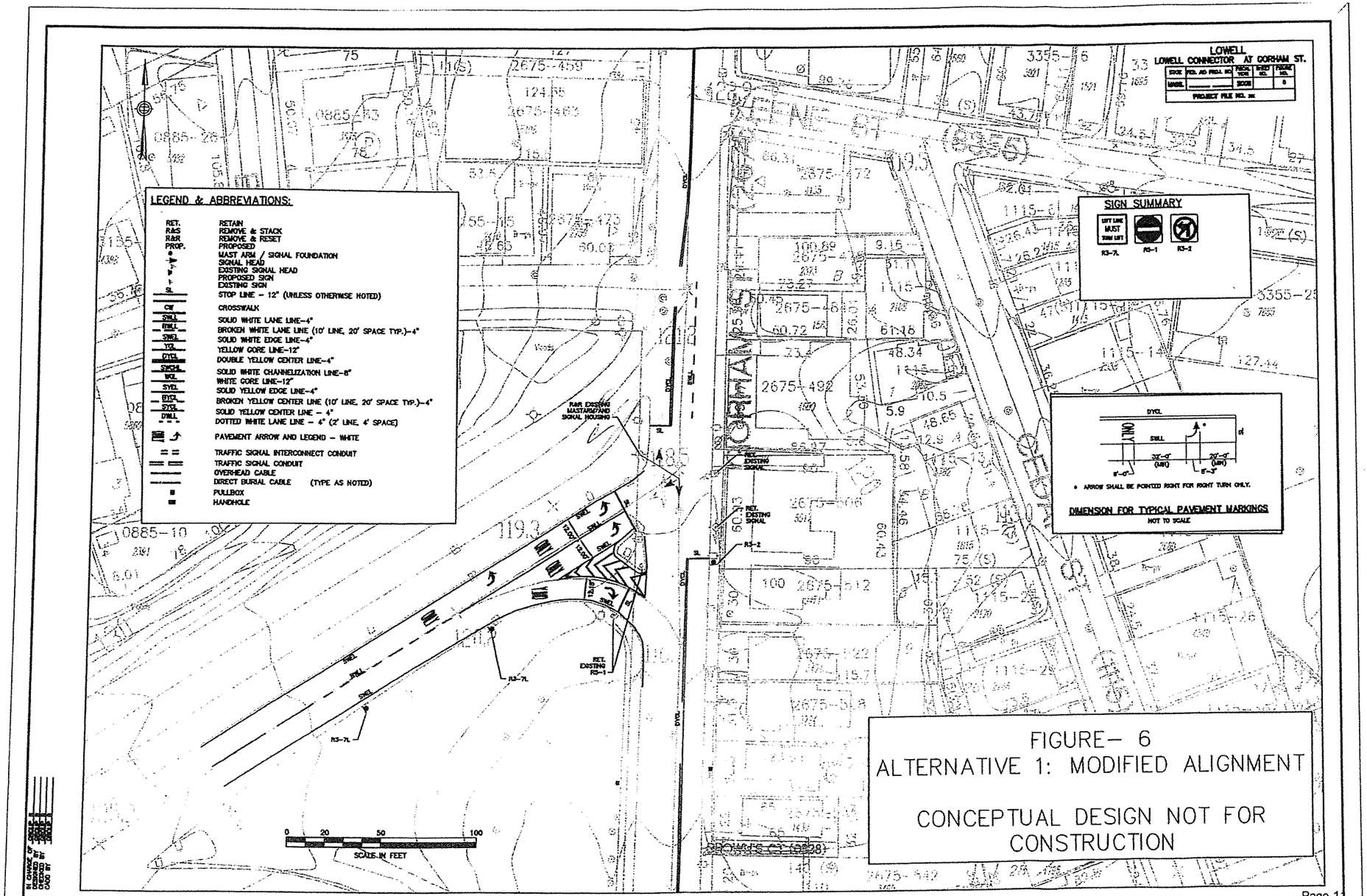
T- 24

Appendix E. Other Information

The following pages present design concepts for the site that were developed during earlier studies.

Some of these are discussed within this Road Safety Audit report, and will be developed in more detail during this project's Functional Design Report stage.

Elements of the earlier studies pertaining to Lowell Connector southbound may be modified to reflect a prospective reduction of that segment to one lane, in concert with another project on Thorndike Street.


LOWELL
LOWELL CONNECTOR AT GORHAM ST.
LEGEND & ABBREVIATIONS:
RET. RETAIN
R&S REMOVE & STACK
R&R REMOVE & RESET
PROP. PROPOSED
MAST ARM / SIGNAL FOUNDATION
SIGNAL HEAD
EXISTING SIGNAL HEAD
PROPOSED SIGN
EXISTING SIGN
STOP LINE – 12" (UNLESS OTHERWISE NOTED)
CROSSWALK
SWL1 SOLID WHITE LANE LINE–4"
BWL1 BROKEN WHITE LANE LINE (10' LINE, 20' SPACE TYP.)–4"
SWEL SOLID WHITE EDGE LINE–4"
YCL YELLOW CORE LINE–12"
DYCL DOUBLE YELLOW CENTER LINE–4"
SWCHL SOLID WHITE CHANNELIZATION LINE–8"
WCL WHITE CORE LINE–12"
SYEL SOLID YELLOW EDGE LINE–4"
BYCL BROKEN YELLOW CENTER LINE (10' LINE, 20' SPACE TYP.)–4"
SYCL SOLID YELLOW CENTER LINE – 4"
DWLL DOTTED WHITE LANE LINE – 4" (2' LINE, 4' SPACE)
PAVEMENT ARROW AND LEGEND – WHITE
TRAFFIC SIGNAL INTERCONNECT CONDUIT
TRAFFIC SIGNAL CONDUIT
OVERHEAD CABLE
DIRECT BURIAL CABLE (TYPE AS NOTED)
PULLBOX
HANDHOLE
SIGN SUMMARY
LEFT LANE MUST TURN LEFT
R3-7L
R5-1
R3-2
DYCL
SWLL
32'-0" (MIN)
20'-0" (MIN)
8'-0"
8'-0"
* ARROW SHALL BE POINTED RIGHT FOR RIGHT TURN ONLY.
DIMENSION FOR TYPICAL PAVEMENT MARKINGS
NOT TO SCALE
RAR EXISTING MASTARM/HAND SIGNAL HOUSING
REM. EXISTING SIGNAL
REM. EXISTING R3-1
R3-7L
R3-2
SCALE IN FEET
0 20 50 100
BROWN CT (PRIV)
LOWELL CONNECTOR
2675-459
2675-463
2675-472
2675-473
2675-46
2675-492
2675-506
2675-512
2675-518
2675-522
0885-26
0885-10
0885-63
3355-6
3355-23
1115-6
1115-14
1115-26
1115-28
FIGURE– 6
ALTERNATIVE 1: MODIFIED ALIGNMENT
CONCEPTUAL DESIGN NOT FOR CONSTRUCTION

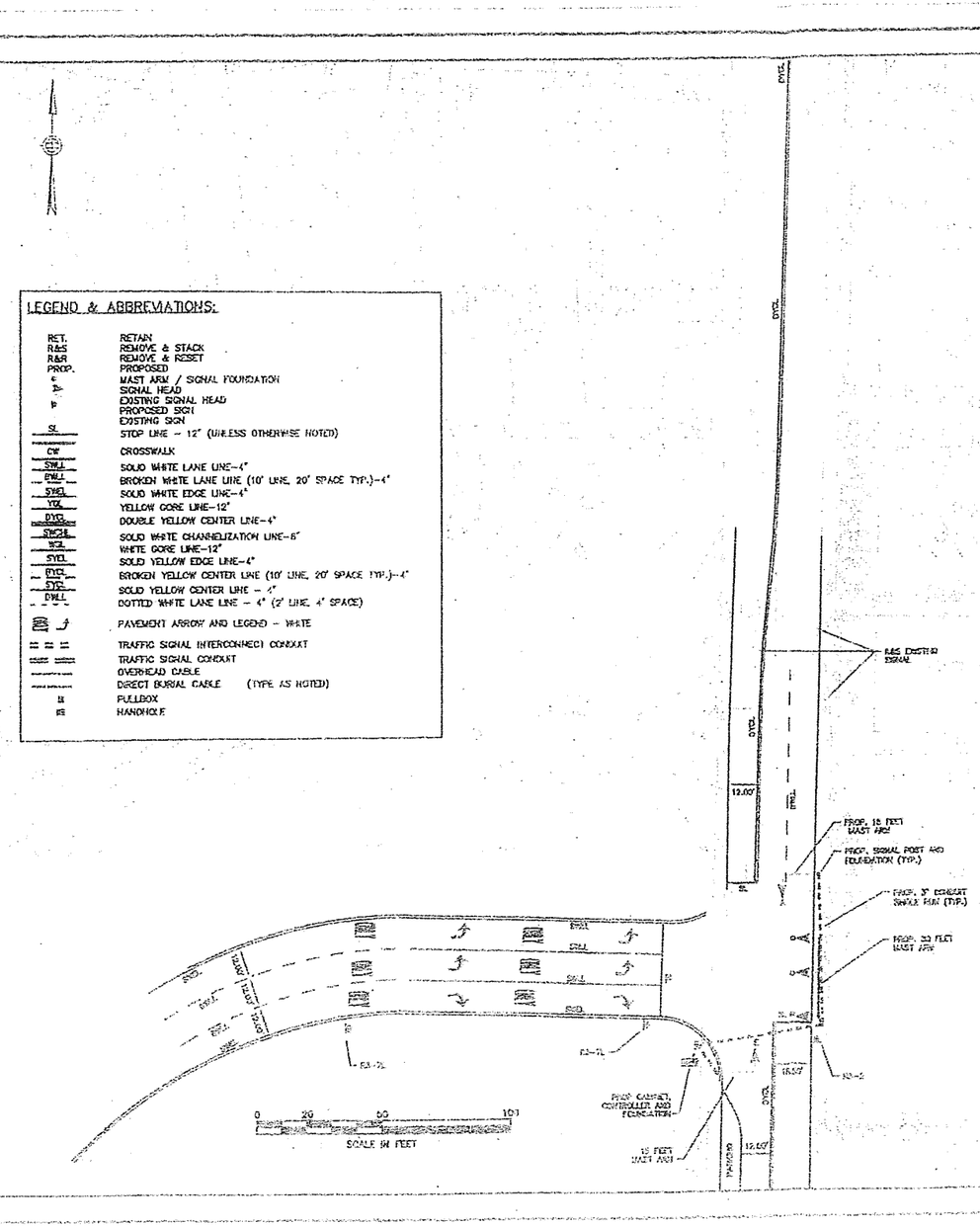
LOWELL

LOWELL CONNECTOR AT CORNHILL ST.

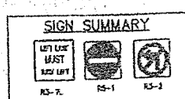
STATE	FED. AID PROJ. NO.	PROJ. YEAR	SHEET NO.	TOTAL SHTS.
MASS.		SIGNS		7
PROJECT FILE NO. xx				

LEGEND & ABBREVIATIONS:

RET.	RETAIN
R&S	REMOVE & STACK
R&R	REMOVE & RESET
PROP.	PROPOSED
⊏	MAST ARM / SIGNAL FOUNDATION
⊐	SIGNAL HEAD
⊏	EXISTING SIGNAL HEAD
⊐	PROPOSED SIGN
⊏	EXISTING SIGN
SL	STOP LINE – 12" (UNLESS OTHERWISE NOTED)
CW	CROSSWALK
SWLL	SOLID WHITE LANE LINE–4"
BWLL	BROKEN WHITE LANE LINE (10' LINE, 20' SPACE TYP.)–4"
SWEL	SOLID WHITE EDGE LINE–4"
YGL	YELLOW GORE LINE–12"
DYCL	DOUBLE YELLOW CENTER LINE–4"
SWCHL	SOLID WHITE CHANNELIZATION LINE–8"
WGL	WHITE GORE LINE–12"
SYEL	SOLID YELLOW EDGE LINE–4"
BYCL	BROKEN YELLOW CENTER LINE (10' LINE, 20' SPACE TYP.)–4"
SYCL	SOLID YELLOW CENTER LINE – 4"
DWLL	DOTTED WHITE LANE LINE – 4" (2' LINE, 4' SPACE)
	PAVEMENT ARROW AND LEGEND – WHITE
	TRAFFIC SIGNAL INTERCONNECT CONDUIT
	TRAFFIC SIGNAL CONDUIT
	OVERHEAD CABLE
	DIRECT BURIAL CABLE (TYPE AS NOTED)
	PULLBOX
	HANDHOLE

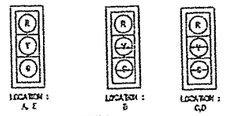


SIGN SUMMARY



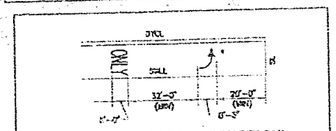
SIGNAL HEAD DATA

NOT TO SCALE



NOTES

1. ALL SIGNAL INDICATIONS HEADS SHALL BE 12" DIA. LED LENS.
2. SIGNAL INDICATIONS SHALL HAVE TUNNEL VISORS.
3. ALL SIGNAL INDICATIONS SHALL HAVE 6" LOUVERED BACKPLATES.



DIMENSION FOR TYPICAL PAVEMENT MARKINGS

NOT TO SCALE

FIGURE– 7
ALTERNATIVE 2: T INTERSECTION
CONCEPTUAL DESIGN NOT FOR CONSTRUCTION

LOWELL

LOWELL CONNECTOR AT GORHAM ST.

DATE	FED. AID PROJ. NO.	PROJ. NO.	SHEET NO.	TRAFFIC NO.
1/2005		2005		
PROJECT FILE NO.				

LEGEND & ABBREVIATIONS:

RET.	RETAIN
R&S	REMOVE & STACK
R&R	REMOVE & RESET
PROP.	PROPOSED
	MAST ARM / SIGNAL FOUNDATION
	SIGNAL HEAD
	EXISTING SIGNAL HEAD
	PROPOSED SIGN
	EXISTING SIGN
SL	STOP LINE – 12" (UNLESS OTHERWISE NOTED)
CW	CROSSWALK
SWLL	SOLID WHITE LANE LINE–4"
BWLL	BROKEN WHITE LANE LINE (10' LINE, 20' SPACE TYP.)–4"
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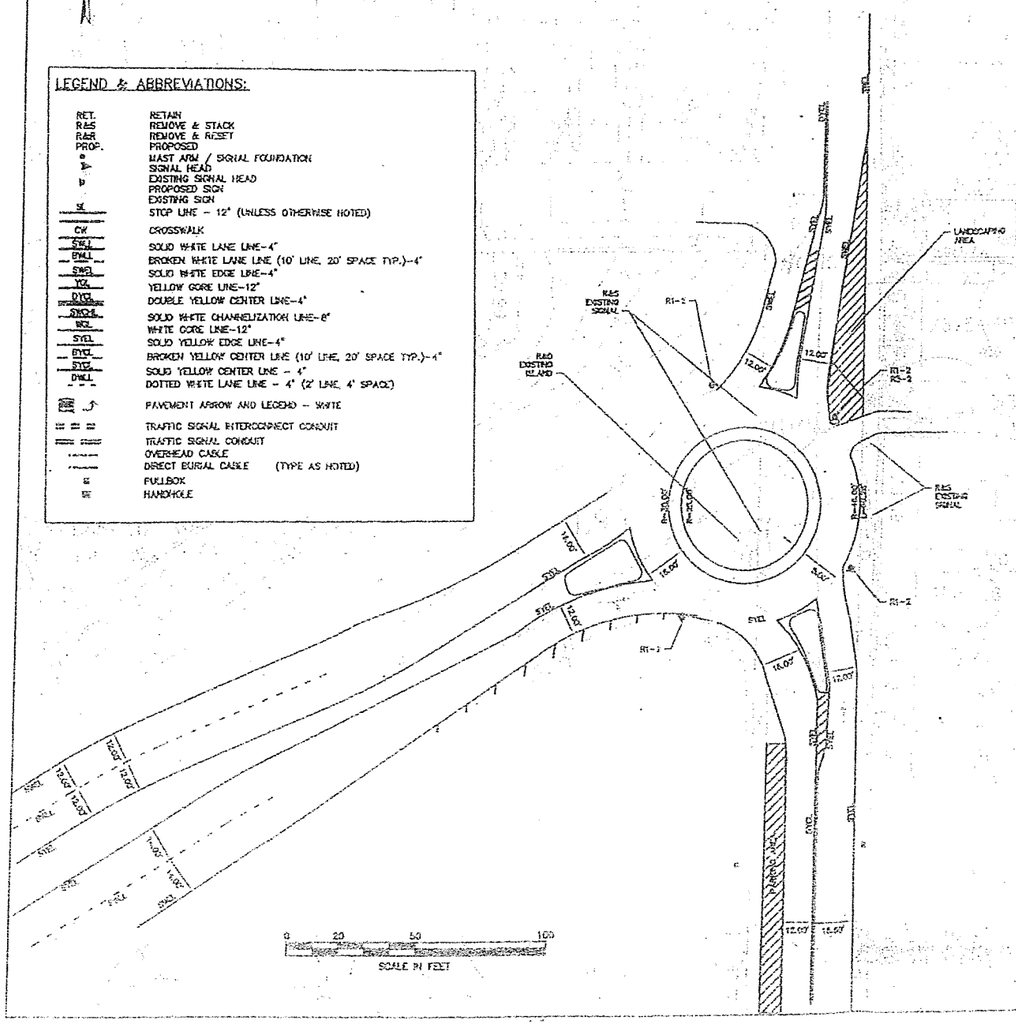
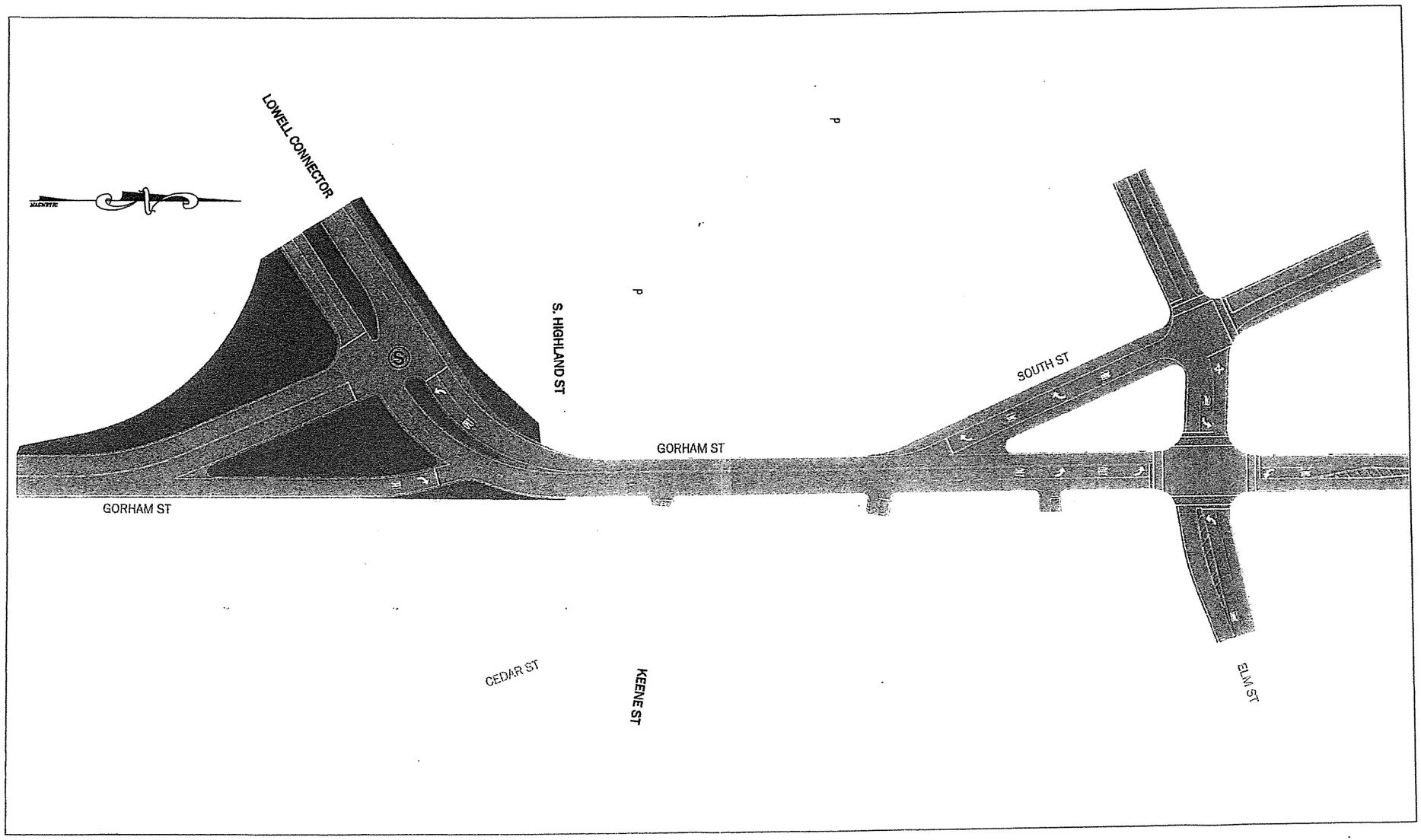
	TRAFFIC SIGNAL CONDUIT
	OVERHEAD CABLE
	DIRECT BURIAL CABLE (TYPE AS NOTED)
	PULLBOX
	HANDHOLE



SIGN SUMMARY

R1-2 R3-2

FIGURE– 8
ALTERNATIVE 3: ROUNDABOUT
CONCEPTUAL DESIGN NOT FOR CONSTRUCTION



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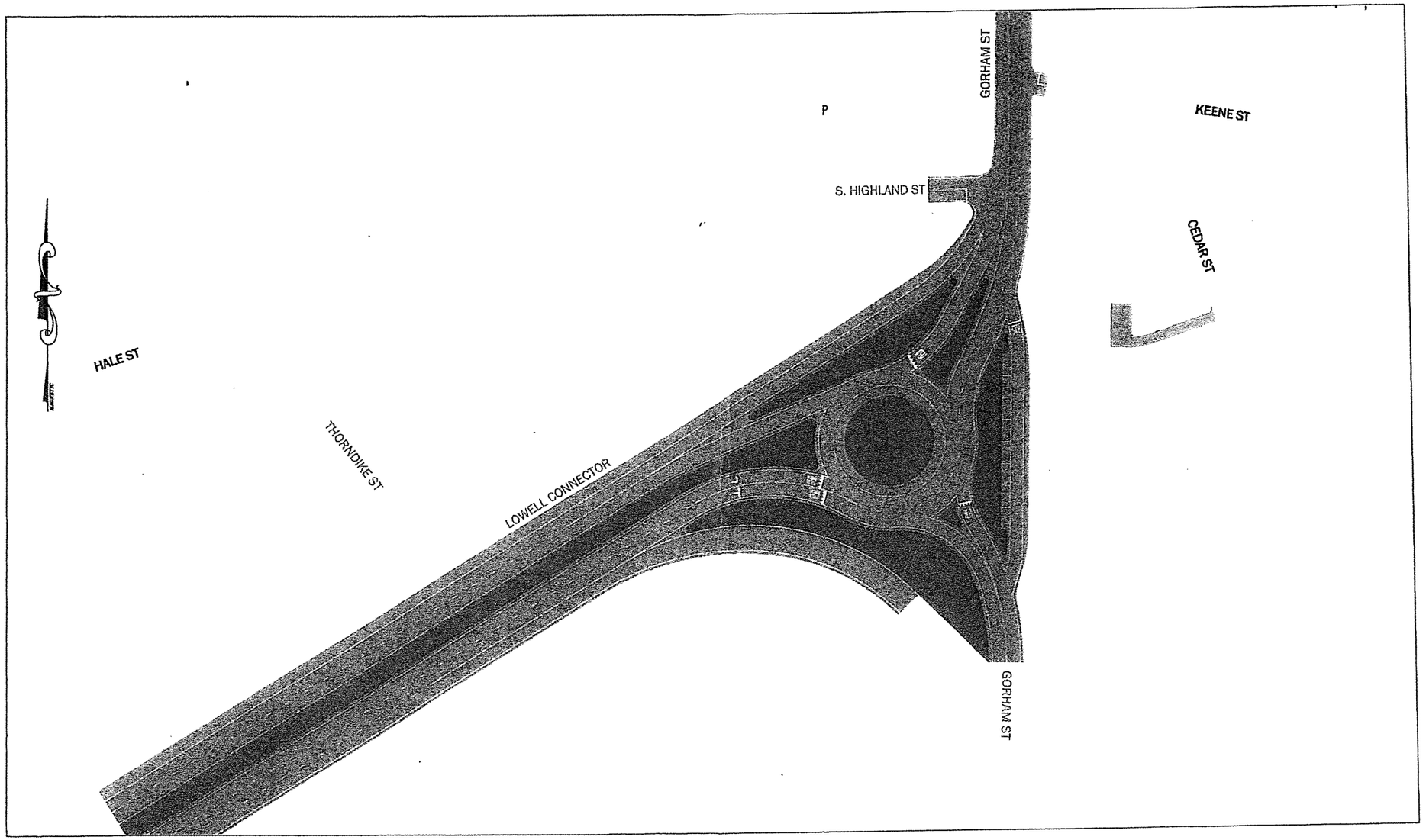
LOWELL CONNECTOR / GORHAM STREET
CONCEPT 1



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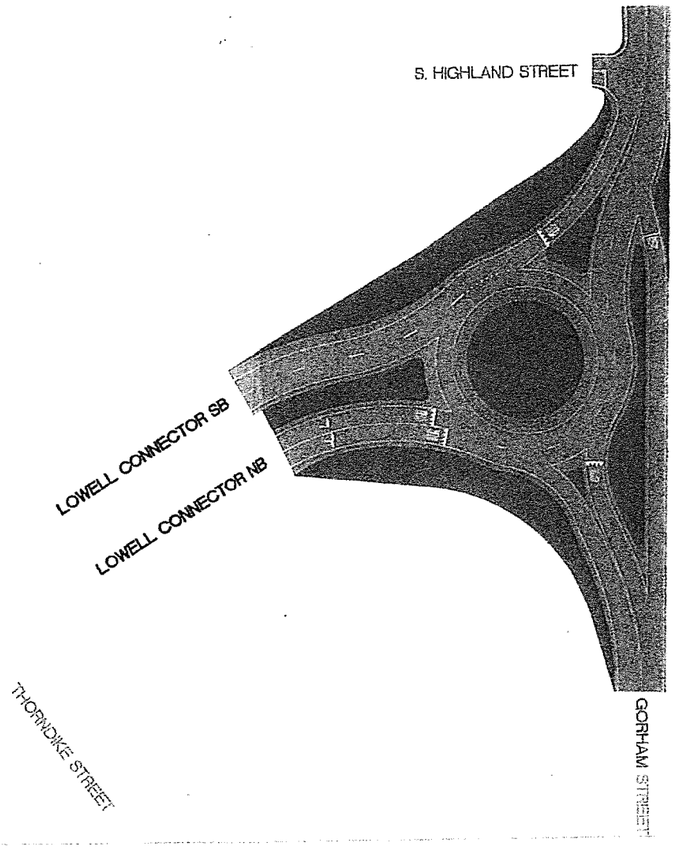
SCALE IN FEET

LOWELL CONNECTOR / GORHAM STREET
CONCEPT 2



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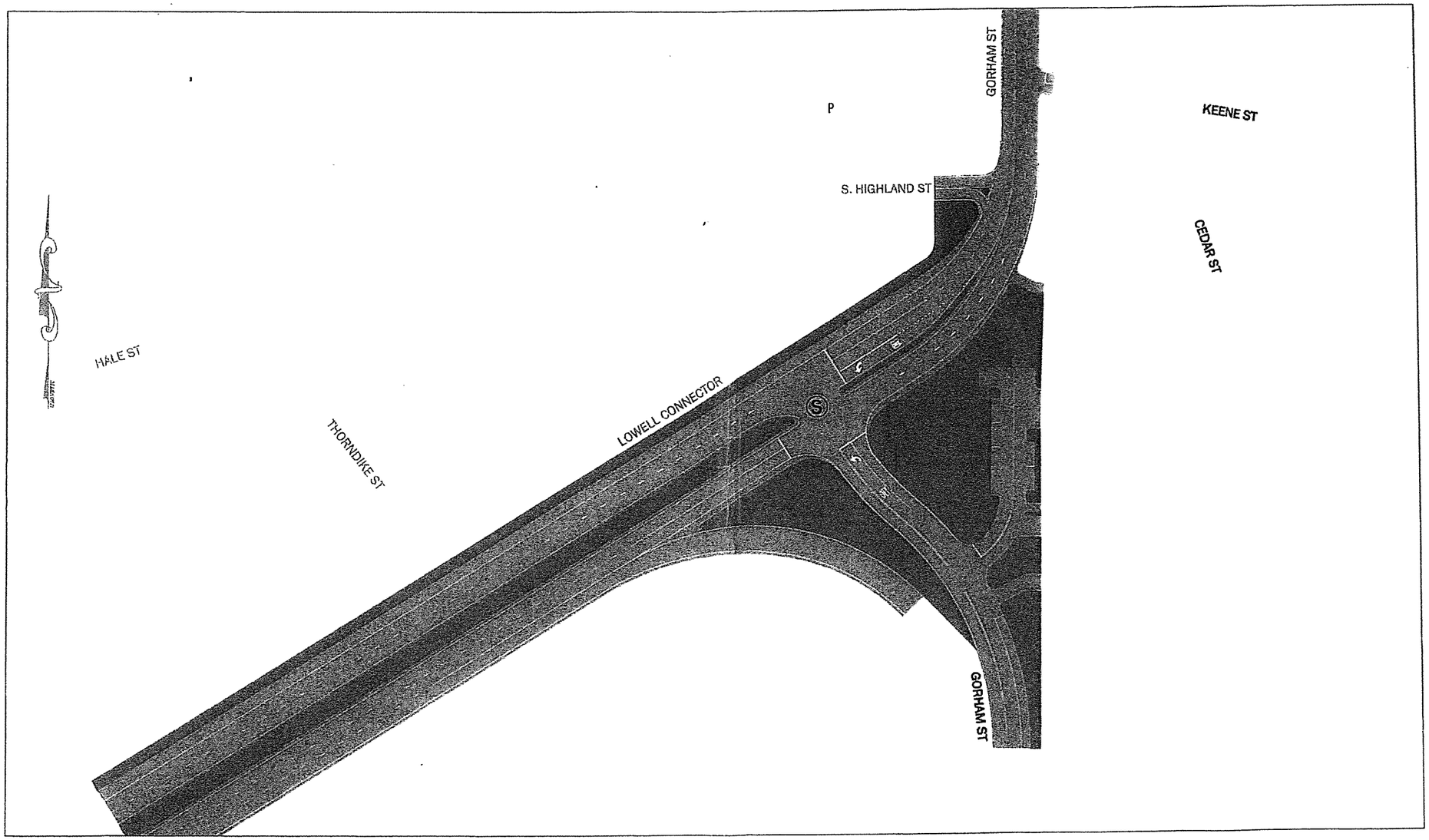
LOWELL CONNECTOR / GORHAM STREET
CONCEPT 2A



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CONCEPT 3